Workshop on Energy Security concerns and response strategies for South Asia

February 10, 2001, New Delhi

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WORKSHOP ON ENERGY SECURITY CONCERNS AND RESPONSE STRATEGIES FOR SOUTH ASIA
FEBRUARY 10, 2001

Venue: Jacaranda (Convention Centre)
India Habitat Centre, Lodhi Road, New Delhi.

Time	**Session**	**Chairpersons, Speakers and Panellists**
8:30 a.m. – 9:00 a.m. **Registration**		
9:00 a.m. - 10:00 a.m.	**Inaugural Session**	
	Opening remarks & welcome address	**Dr R K Pachauri** *Director, TERI*
	Inaugural address	**Mr Suresh Prabhu** *Hon'ble Minister of Power, Government of India*
	Presentation of background paper	**Dr R K Pachauri** *Director, TERI*
	Vote of thanks	**Mr Ardhendu Sen** *Senior Fellow, TERI*
10:00 a.m. - 10:15 a.m. **Tea**		
10:15 a.m. - 11:15 a.m.	**Session 2** **Global Energy Security Concerns:** • Concerns for oil producing and consuming countries • Energy and Environment: Twin Challenges • Impact of oil supply disruptions: lessons from the past	**Chairperson**: Dr Hoesung Lee *President, Council on Energy and Environment, Korea* **Panelists:** • Mr Vikram Mehta *Chairman, Shell India* • T Masuda *Director, International Energy Agency* • Lt. Gen. V R Raghavan *Director, Delhi Policy Group*

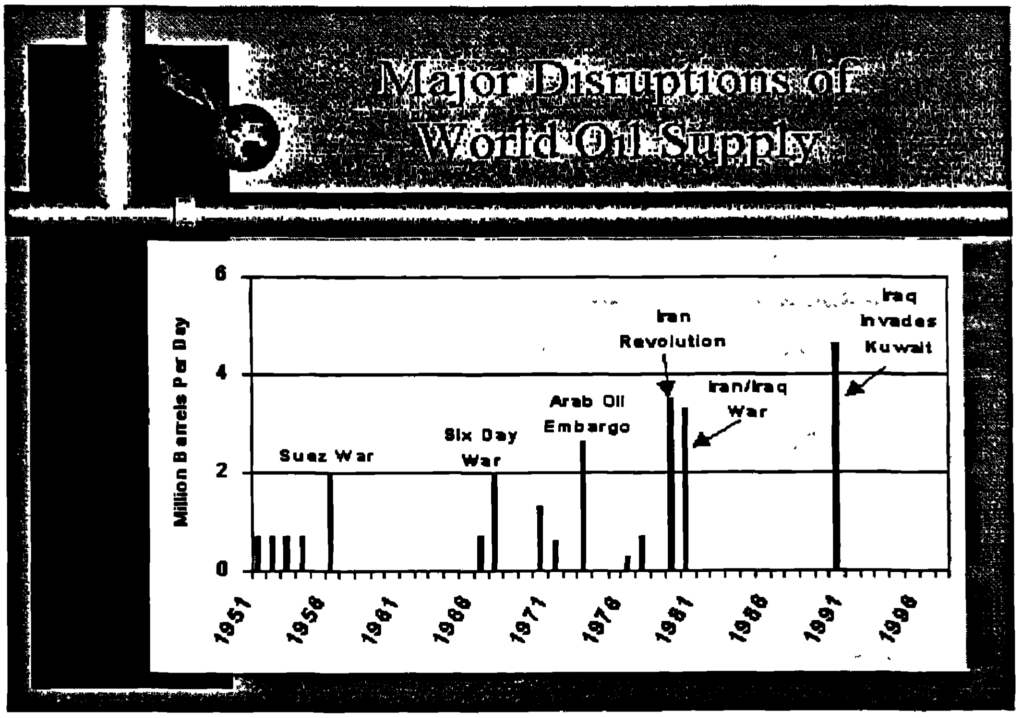
11:15 a.m. - 12:45 p.m.	**Session 3** **Developing Strategies for Energy Security** • Diversification of fuel supply sources • Developing alternative energy technologies • Mechanisms for promoting energy efficiency • Integrating energy markets in South Asia: Prospects for developing regional electricity and gas grids	**Chairperson:** Ambassador Farooq Sobhan **Speakers: Presentation of issues** • Mr Ron Somers *President, Unocal Bharat* • Mr Hilal A Raza *Director General, Hydrocarbon Development Policy Institute, Pakistan* **Panelists:** • Mr Sugeeswara Senadhira *RCSS Sri Lanka* • Commodore Ranbir Talwar *DDGDPS/ COSC* *Ministry of Defence*
12.45 p.m.- 1:30 p.m.	**Valedictory Session: Setting an agenda for the future**	**Chairperson:** Mr N N Vohra *Director IIC* **Panelists** • Dr R.K Pachauri *Director, TERI* • H E Mr Lyonpo Dago Tshering *Ambassador* *Royal Bhutanese Embassy*
1: 30 p.m.	**Lunch**	

Energy security concerns and response strategies for South Asia

Introduction

Energy security issues emerged in the early seventies with the onset of the Arab oil embargo in 1973 when crude prices jumped from USD 2/bbl to more than USD 10/bbl. The 1973 oil price increase cost the industrialised nations over 2 to 4 percent of their GDP. The increase in oil import bill for developing economies was estimated at about $ 4.5 billion. In all there have been six major oil supply disruptions till date when world crude supply fell short by more than 2 million barrels per day (Figure 1).

Figure 1 World oil supply disruptions



Source: EIA Website

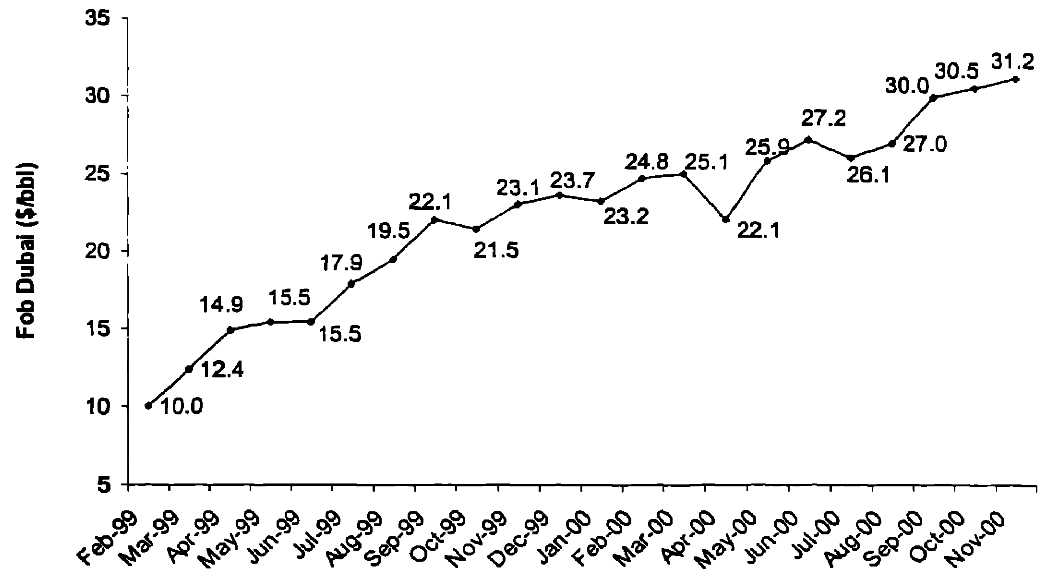
In 1990, during the Gulf War, oil prices rose beyond USD 40/bbl on account of actual supply shortage and panic buying by traders. The adverse impact of the oil price rise in 1990/91in South Asia ranged between 1.2% (India) of the GDP to as much as 4.5% (Sri Lanka).

Policy makers the world over have, thus, been promulgating various measures to combat the adverse effects of the oil shocks. Their efforts, primarily, have been focussed at reducing vulnerability to short-term oil supply disruptions. In the present context, however, energy security concerns, in their widest sense encapsulate three facets. The first, of course, involves limiting the vulnerability to oil supply disruptions. The second pertains to the long-term concerns of smooth functioning of the international energy markets so as to ensure supplies to meet the rising demand at reasonable prices. Finally, a new dimension that has emerged recently, predicates that production and use of energy must evolve so as to minimise the damage to the environment and to promote sustainable development.

While energy security issues were revisited by policy makers in the wake of the Gulf War, with oil prices falling to an all time low of USD 10/bbl in February 1999, energy security issues were put on the back-burner. Over the past couple of years, however, OPEC's (Organisation of Petroleum Exporting Countries) ability to influence oil prices has become more than apparent. The Dubai crude marker, the benchmark crude for Indian crude imports, crossed the USD 30/bbl barrier in October 2000 (Figure 2). On account of the spiralling oil prices, India's oil import bill for 1999//00, initially pegged at USD 6 billion, actually closed at USD 10.5 billion. The oil import bill for the year 2000/01 is estimated to be of the order of USD 17 billion. A similar situation has been observed in other areas of the region, as in Pakistan where the oil import bill for the first four months of the current fiscal is higher by Rs 33 billion.

The developments over the past year have pushed energy security, in particular oil security issues, to the forefront. The following sections examine the energy scenario in South Asia in light of the above mentioned.

Figure 2 Trends in oil prices

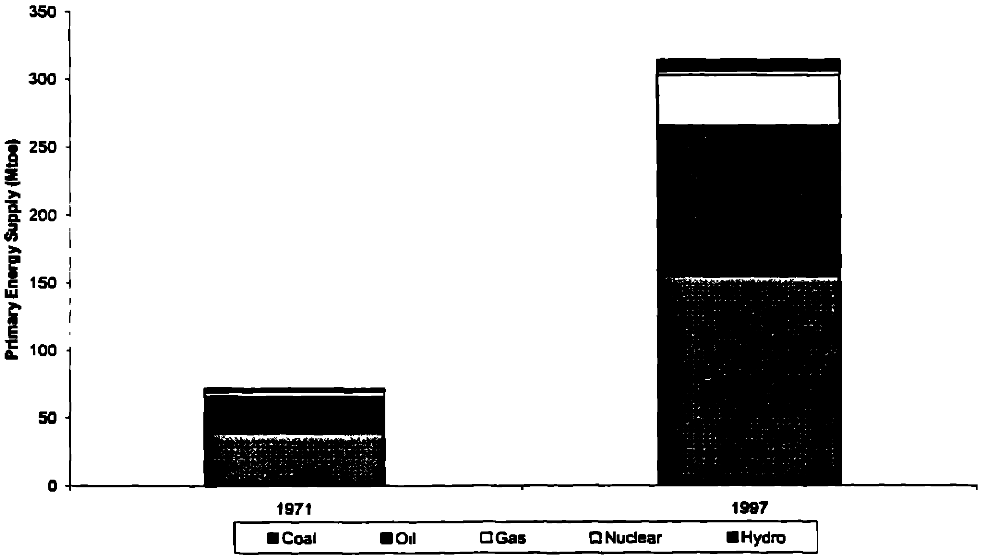


Source: OPEC Bulletin

Energy scenario in South Asia

Economic and population growth in South Asia has resulted in a rapid growth in energy demand. The region's energy demand increased from 72 Mtoe in 1971 to 315 Mtoe by 1997, registering an annual growth rate of 6% during the period.

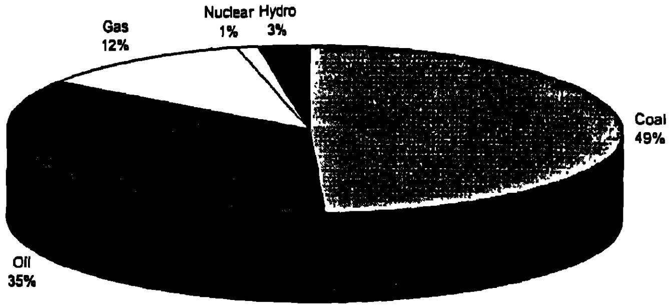
Figure 3 Growth in primary energy supply in South Asia



Source: WEO, 2000

The region's energy mix is dominated by coal, with coal accounting for 49% of the primary energy supply in 1997. While the share of oil at 35% is close to the world average, the share of gas in the primary energy mix at 12% is well below the world average of 23% (Figure 4).

Figure 4 Primary energy mix in South Asia: 1997



Source: WEO, 2000

Long-term estimates for South Asia's fuel mix, indicate a declining share of coal in the primary energy mix with an increasing reliance on gas as an energy source (Table 1).

Table 1 Projected primary energy mix in South Asia (%)

Year	Coal	Oil	Gas	Hydel	Nuclear
1997	49	35	12	3	1
2010	45	36	15	2	1
2020	41	36	19	2	1

Source: WEO 2000

However, even with a declining share of coal in the primary energy mix, absolute coal requirements rise to 516 MMT by 2020. While the demand for oil is expected to grow at an annual growth rate of 4.5% till 2020, gas demand rises sharply at a rate of 6.7% on account of the projected fuel mix (Table 2).

Table 2 Projected requirement of fossil fuels

Fuel	Units	1997	2010	2020
Coal	MMT	233	378	516
Oil	MMT	111	203	304
Gas	BCM	33	78	147

Source: WEO 2000

On the supply side, fossil fuel resource endowments in India by far exceed those of any other country in the region (Table 3).

Table 3 Resource endowments and production levels for fossil fuels in South Asia

Fuel	Units	Bhutan	Nepal	Sri Lanka	Bangladesh	Pakistan	India	Total
Reserves								
Coal	MMT	1.3	2.0			3228	79106	82337
Oil	MMT				8	28	715	751
Gas	BCM				300	612	675	1587
Current Production								
Coal	MMT	0.001	0.01			4	359	363
Oil	MMT				0.08	3	33	36
Gas	BCM				9	20	27	56

Source: EIA Country Analysis Briefs; TEDDY 1999/2000

Recoverable reserves for oil in India, which had peaked at 806 MMT in 1991 for oil and at 735 BCM in 1992 for gas, now stand at 715 MMT and 675 BCM respectively. However, with domestic crude production at 33 MMT only, bulk of the country's crude requirements are imported. In order to boost domestic oil and gas production, the Indian Government announced the New Exploration and Licensing Policy (NELP) in 1999, offering blocks on attractive terms to operators. The NELP attracted 45 bids for 27 Blocks. Subsequently the Petroleum Ministry approved the award of 25 blocks and production sharing contracts for 22 blocks have been finalised. The second round of the NELP was announced in December 2000 with another 25 blocks on offer. Road-shows for the same are currently underway. Exploration under NELP has had some early success in that nearly USD 250 million has been committed for exploration in the 25 blocks awarded in the first round. Since about 35% of Indian sedimentary basins have been explored so far, it would be reasonable to expect that sustained exploration would result in increased production.

It may be noted that in February 1999, the Indian Government had also set up the group on India Hydrocarbon Vision 2025 under the Chairmanship of the Finance Minister to develop a long-term strategy for the development of the hydrocarbons sector. The Group's recommendations for enhancing domestic crude production included,

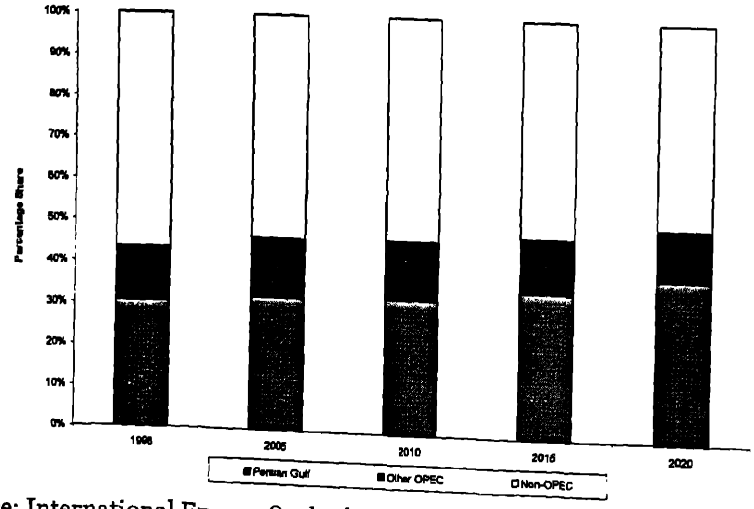
- 100% exploration coverage of Indian sedimentary basins by 2025
- Extensive exploration in frontier and deep water areas
- Offering of attractive fiscal terms
- Acquisition of acreages abroad for exploration and production

At current production levels, however, while the R/P ratio (Reserves to production) for coal for South Asia exceeds 200 years, the same for oil and gas is low at 21 and 27 years respectively. It is inevitable, hence, that the region's import dependence for oil and gas will increase considerably in the future.

Asian oil imports are primarily concentrated from the Gulf. In 1999, of the total of 389 MMT of oil imports into Asia-Pacific, Middle East exports accounted for 75% of the trade, while imports from West Africa accounted for another 10%. The Gulf currently holds 65% of the worlds proven reserves of crude oil. In the aftermath of the oil price shocks of 1973 and 1979, the Gulf lost its predominance as an oil supplier in the mid 1980s. The combined share of crude production from the Persian Gulf in aggregate world production stood at around 30% in 1970, rose to around 35% in the mid-1970s and fell down to as low as 18% in the mid-1980s. Since then, it has been rising and in 1997 it had resumed the early 1970 share.

As per US EIA (Energy Information Administration) forecasts, share of oil production from the Persian Gulf is expected to progressively rise from the current 30% to about 40% by the year 2020 (Figure 5).

Figure 5 World oil production capacity by region (Percentage share)



Source: International Energy Outlook-2000,EIA

Further, OPEC petroleum exports to developing countries are expected to increase by almost 16 million barrels per day over the forecast period, with more than half the increase going to the developing countries of Asia. It is thus, inevitable, that developing Asia would be in the long run increasing its dependence on the Persian Gulf.

Energy Security Concerns

With the Gulf region prone to political turmoil, the security of supplies from the Gulf becomes a prominent issue. In the past, oil supplies have been disrupted on at least seven occasions since 1950 (Iranian Boycott 1951-53, Suez Crisis 1956, Six-day War 1967, Yom Kippur War 1973, Iranian revolution 1979, Iran/Iraq war 1980, Gulf Crisis 1991). All these disruptions were due to political causes and were not market driven. In some cases there were strong market price responses of varying durations, in other cases the spare capacity available was able to substitute for the disrupted supply and there were limited price effects.

The possibilities of supply disruptions also arise from the pattern of trade flows. Imports to South Asia from the Gulf utilise the Strait of Hormuz, which connects the Persian Gulf to the Gulf of Oman and the Arabian Sea. As per EIA estimates, the Strait recorded a transit volume of 15.4 million barrels of oil per day in 1998. Closure of the Strait of Hormuz, by accident or design, practically cuts of Gulf supplies to the East altogether. Likewise, the Strait of Malacca, connecting the Indian Ocean with the Pacific Ocean, accounted for an estimated 9.4 million barrels of oil per day in 1997. If the strait was closed, the requirement of additional vessel capacity would absorb all excess capacity, resulting in tanker freights spiralling upwards.

Open access to sea lanes of communication between the Persian Gulf and Asia is thus vital for Asian economies. US naval presence in the region has assured freedom of navigation as yet. However, if US naval presence were to diminish or other states in the region were to exert a stronger presence, security of sea lanes could be under threat.

In addition, while there has been a policy shift towards deregulation of the energy sector in Asia, reliance on market forces alone in provision of resources vital to national security is being questioned. In India, for instance, the Ministry of Petroleum and Natural Gas is keen on a strategic status for public sector oil companies so that Government control may be retained in provision of petroleum products. It may be noted, however, that the Government has also recognised the inability of public sector companies to put up the required investments for infrastructure development, viz. pipelines, depots/terminals, etc. Liberalisation, in energy markets, thus, is necessary to attract private capital, which in turn would improve the ultimate deliverability of petroleum products/gas, enhancing energy security.

The efficacy of market forces in determination of global oil prices, however, is less apparent. Future price shocks are not only likely to be caused by disruptions following wars, political disturbances etc., but also through planned embargoes and production cuts. The last year witnessed a sustained rise in oil prices on account of OPEC members resolving to production cuts. Although OPEC has been targeting oil prices between $22/bbl and $28/bbl, oil prices over the past few months have remained well over this target range. While there was some downward pressure on oil prices in December 2000, primarily on account of high inventories in the US, oil prices have started creeping upwards again with the winter demand and the OPEC production cut of 1.5 million barrels per day announced on 17th January 2001.

Relevance of policy objectives

In recent years, the South Asian region has been recognised as an area of increasing interest due to its vast size and opportunities for trade and economic ties. President Clinton's recent visit to South Asia has heralded India's centrality to the U.S. policy in South Asia, and a new economic emphasis in the U.S.-Indian relations. In the coming years India and the US are expected to make a strong start on a series of high-level consultations and negotiations for trade and economic ties. There is also hope that the presidential visit will inspire some key decisions on energy contracts and development policy in India and Bangladesh. India also hopes for early lifting of sanctions imposed after the 1998 nuclear tests that restrict U.S. high technology exports and lending to India from international financial institutions. This could open up markets, for instance, for supply of new and efficient technologies.

The Joint Statement on Co-operation in Energy and Environmental Aspects that was signed in October 1999, between the DOE and the Government of India, has led to an enhanced policy dialogue and the South Asia Regional Initiative on clean energy development. These mechanisms could provide appropriate vehicles for promoting co-operation for integrating regional and international energy markets, and promoting co-operation in science and technology for the development of clean and efficient energy systems.

Response strategies

Substitution

Clearly, one of the first options to be examined is that of substitution of oil by other forms of energy. An analysis of the sectoral oil consumption in South Asia indicates that the transport sector accounted for 53% of the total oil consumption in 1997. A successful substitution must therefore address the transport sector.

Substitution by coal

Coal can replace oil in the transport sector only as electricity. This substitution is an ongoing process in the railways with electrification of railway tracks. However, it may be noted that in India, of the total diesel consumption of 37 MMT in 1998/99, the railways accounted for a mere 1.6 MMT only. Substituting diesel by power in railways would thus have a marginal impact only. The bulk of the diesel is used by the road traffic. In this sector, electricity is yet to make an impact although BOVs (Battery Operated Vehicles) are an active area of research.

Substitution by Gas

The possibilities of substituting oil by natural gas in the transport sector are much brighter. While there are limited possibilities of gas substitution as electricity as well, the feasibility of direct substitution is much higher:

- CNG (Compressed Natural Gas) – While in Pakistan about 100,000 vehicles have been converted to CNG with 120 filling stations across the country, the progress has been much slow in Bangladesh. The Bangladesh Government, however, plans to promote CNG use and set up 51 stations across the country by 2003. In India, over 30,000 vehicles have been converted to run on CNG in Mumbai and Delhi. Further substitution is possible only in cities located along existing pipeline networks like the Hazira-Jagdishpur-Bijaipur (HBJ) pipeline. Gas volumes associated with CNG use alone would not justify establishment of new infrastructure.
- LPG (liquefied petroleum gas) – LPG, fractionated from natural gas, can be supplied in all the towns and cities and the possibilities are much greater than CNG. While the Indian Government has recently approved the use of LPG in cars, Pakistan is considering disallowing the use of LPG in cars to give protection to the CNG industry.

- Fuel cells – this is by far the most promising application of natural gas in this area. A lot of research is being conducted in this area and it is expected that the technology should be commercially available by 2010.
- Di-methyl Ether (DME)- Although DME can be produced from a variety of hydrocarbon feedstocks, natural gas is most widely used in commercial production today. DME is a versatile fuel, which finds usage in transport, power generation, domestic use, etc. Recently, IOC and GAIL have announced their intentions to put up a joint project with BP for production of DME.

Gas Imports: Pipelines

Current gas production in South Asia is estimated at 56 BCM, with India accounting for about 50% of the total production. Domestic availability in India is, however, expected to decline in the future. As per estimates made by the Group on India Hydrocarbon Vision 2025, domestic gas production by 2025 is expected to decline to 13 BCM from the current 27 BCM. Indian gas requirements are, thus, likely to be met primarily from gas imports.

Outlook on gas production in Bangladesh is optimistic. While current gas reserves are estimated at 10.6 TCF, opinions on actual reserves vary from 30-50TCF. A detailed re-assessment of reserves is currently underway. The oil major, Unocal, has struck significant gas finds – Jalalabad, Bibiyana, and Moulvi Bazaar- in Bangladesh. The company is keen on exporting gas from the Bibiyana gas field to India via a 0.5 bcfd pipeline. While the Bangladesh government is evaluating the proposal, the idea has found opposition from several quarters. Reportedly, the Government would consider gas exports to India only if domestic resources are enough to cater to gas requirements of the country for the next 50 years.

India is also considering gas imports from Iran via Pakistan. In 1995, Pakistan and Iran had signed a preliminary agreement to construct a pipeline from South Pars gas field in Iran to Karachi in Pakistan and a probable extension to India. However, on account of the tension between Pakistan and India, the proposal for a joint gas pipeline has been in limbo for quite some time. The prospects of the same had all but vanished after the recent Kargil War between the two countries.

In early 2000, Pakistan again expressed interest in the Iranian gas pipeline project given that Pakistan expects to earn USD 700 million in transit fees alone. The decision to allow the pipeline project came after a series of discussions between the Pakistani and Iranian petroleum ministry officials. The Indian

Government expressed its reservations in investing in downstream industries based on Iranian gas coming via Pakistan in light of the ongoing tension between the two countries. Meanwhile, Pakistan's military government has reportedly given its clearance to construction an onshore pipeline.

The Indian Government, on the other hand, is more keen on an offshore pipeline to bring Iranian gas to the Indian West Coast, bypassing Pakistan. The Indian Government has held discussions with the National Iranian Gas Company to that effect. The 1000-km 2-BCM deep-sea pipeline between India and Iran is expected to cost about $3 billion. Russian state-owned gas company Gazprom is likely to join hands with Gas Authority of India Ltd (GAIL) in laying the pipeline.

With negotiations still on between the two governments, a shallow water pipeline is currently emerging as the most viable option. This particular option would have to be in accordance with the provisions of the Law of the Seas and would require the definition of the continental shelf of Iran, Pakistan and India. Both Pakistan and Iran, however, are keen on the onshore option, which is the cheapest of the three options under consideration.

Gas imports – Liquefied Natural Gas (LNG)

In view of the problems faced by the pipeline projects, LNG is seen as a solution to the immediate needs for imported gas. A number of LNG projects have been proposed in India (Figure 6). As much as 43 MMT (62 BCM) of annual LNG imports are envisaged through these projects. The anticipated volume is more than twice the current gas production in India. However, only a few are at relatively advanced stages of development. Promoters are currently facing problems on account of the long-term take-or-pay agreements required for LNG supply. State Electricity Boards, the likely anchor load customers, are in a poor state of financial health. Reforms in the power sector would be imperative for promoting LNG projects.

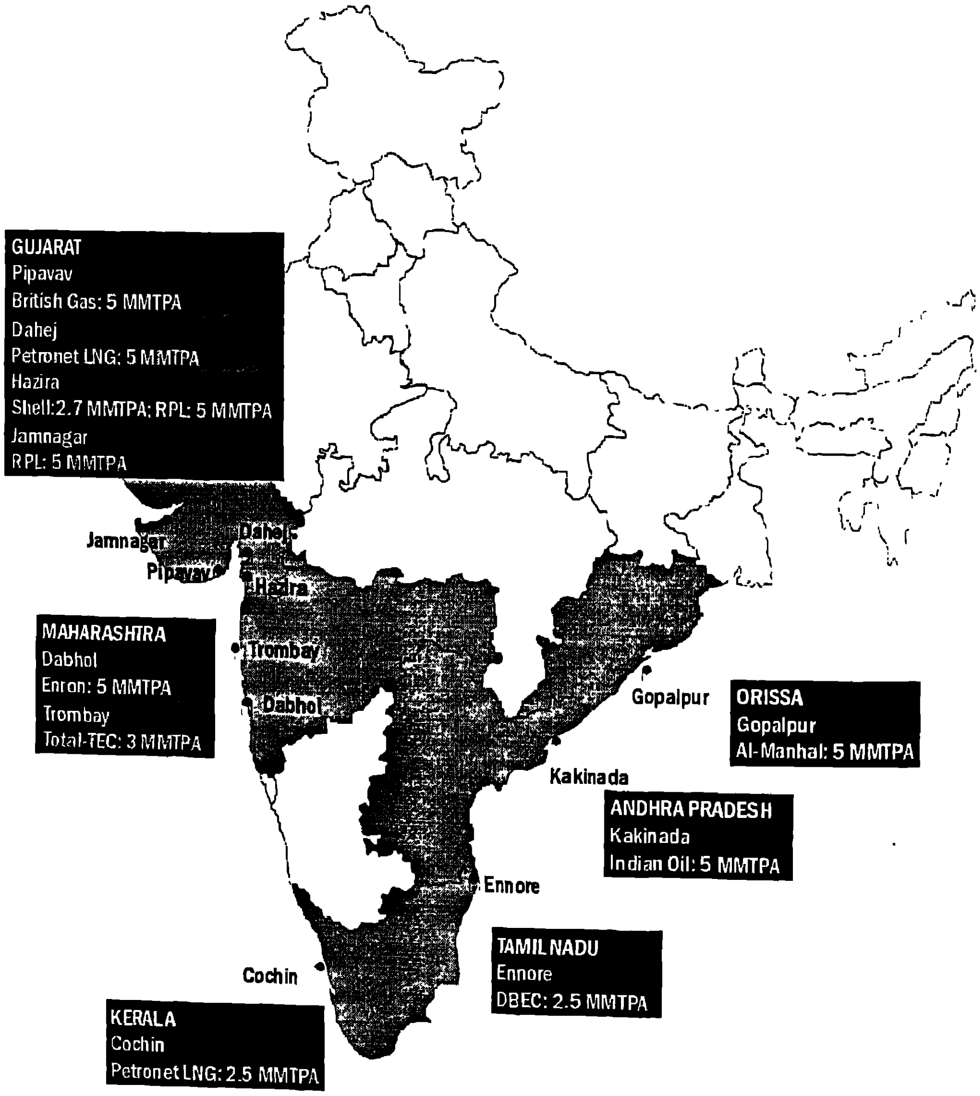
Direct substitution of oil by domestic gas, is therefore, minimal. Domestic gas production, in India and Pakistan, would have to be supplemented with imports. At first sight it may not make sense to replace oil by another fuel which is also going to be largely imported. However, the gas market is different from the international oil market in many important respects. There is no history of supply disruptions in the international gas trade, which is now around 40 years old. Gas prices are not set by a cartel, they are negotiated bilaterally between the buyer and the seller. Although these prices are generally indexed on oil prices, the price variations are not as sharp as in the case of oil.

Alternatives to gas imports

Coal Bed Methane

One of the promising new alternative energy sources is Coal Bed Methane (CBM). CBM is methane permeated in the coal seam matrix. The Indian Government announced a policy for exploration and exploitation of CBM in 1997. The Government has already approved award of a block in Raniganj area in West Bengal to Great Eastern Energy Corporation for CBM exploration.

Figure 6 Prominent LNG terminals in India



While a number of estimates for CBM resources in India have been presented, a conservative estimate pegs the same at 850 BCM, with the Gondwana basin accounting for 837 BCM and 13 BCM in tertiary basins. The exploration programme, as charted by the Directorate General Hydrocarbons, envisages a minimum of 8 years for exploration, pilot assessment and market confirmation. This would be followed by a development phase of 5 years.

Gas Hydrates

A gas hydrate is a crystalline solid consisting of gas molecules, usually methane, each surrounded by a cage of water molecules. Methane hydrate is stable in ocean floor sediments at water depths greater than 300 meters. Since the gas is held in a crystal structure, gas molecules are more densely packed than in conventional gas traps. Gas-hydrate-cemented strata also act as seals for trapped free gas. These traps provide potential resources, but they can also represent hazards to drilling. Production of gas from hydrate-sealed traps is somewhat sustainable in nature as the reduction of pressure caused by production can initiate a breakdown of hydrates and a recharging of the trap with gas.

The National Institute of Oceanography in India has mapped out 6150 TCM of gas hydrates along the southern coastline of the Indian peninsula. The projected hydrate resources are about 9000 times the current gas reserves in India. The National Gas Hydrates Programme launched under the Ninth Five Year Plan involves an outlay of Rs 2130 million. However, unlike CBM, gas production from hydrates is not a commercially proven technology as yet. Further research and development is necessary for commercial exploitation of gas hydrates.

Oil substitution: Other possibilities

Nuclear power

The other possibilities are of substitution by nuclear power and renewables. The installed capacity for nuclear power in India aggregates to 2280 MW. While Pakistan has one nuclear power plant, Kanupp - 137 MW, the Rooppur nuclear power plant in Bangladesh is likely to get commissioned by 2003. In India, the target for 2020 is 20,000 MW. The sector has faced the problem of long gestation periods – it took seven/eight years to set up a power plant – and the consequent high generation cost. In addition decommissioning costs of a nuclear station can be substantial. Although the Nuclear Power Corporation claims to have reduced the period to 4/5 years, the target of 20,000 MW looks ambitious. Even if the target were to be achieved, nuclear power would account for only a small percentage of the total installed capacity.

Renewables

South Asia has a high reliance on renewables. In Bhutan energy from biomass accounts for as much as 98% of the total energy consumed while in Nepal, 500,000 bio-gas units are in use. In addition, both these countries are actively exploiting their hydro resources. In Sri Lanka, biomass consumption is increasing annually at 3% and accounts for about 55% of the total energy consumption. Likewise, non-commercial energy sources account for about half of the total energy consumption in Bangladesh. In India, the installed capacity of power generation from renewables is now about 1600 MW consisting largely of wind power, biomass and small hydro. The new policy on renewables targets 10% of the capacity addition to be based on renewable sources. This translates into an estimated 12,000 MW of generating capacity by 2012. These targets are way below the technically assessed potential in the country but even these may not be achieved as costs continue to be very high.

Efficiency improvements

One important means of reducing oil dependence is through increasing the efficiency of oil use. The developed countries doubled their fuel efficiencies following the first oil shock of 1973. Unfortunately, South Asia has lagged behind in this area. Oil intensity, i.e., oil consumption per unit of value added, in India in 1998 was 0.21 kgoe/USD, while that in Pakistan and Sri Lanka was 0.32 kgoe/USD and 0.25/USD respectively. At the same time the oil intensity in United Kingdom, 0.08 kgoe/USD, was less than half the levels in South Asia.

The following paragraphs illustrate some of the important technological achievements in the US that have aimed at increasing energy efficiency in the transport sector. Some of these technologies are very relevant for the South Asian.

- The public-private partnerships program is designed to advance specific technology components for vehicle applications. Ford, General Motors and Daimler Chrysler have demonstrated the technical feasibility of 80 mpg (miles per gallon) cars, and plan to produce prototypes by the year 2004. By 2010 the entry of advanced automotive technologies is likely to reduce oil demand by 1.2 quads.

- Light weight vehicles program is focused on the development of carbon fiber reinforced polymer matrix composites, magnesium casting, metal-matrix composites, titanium, crashworthiness, repair and recycling. It has been demonstrated that light- weight vehicle technologies allow for 6% increase in fuel efficiency for every 10% reduction in weight. Light weighting is viewed as the second most effective way of improving fuel efficiency next to improvements in propulsion systems. Programs are also underway for advanced combustion and emission control for diesel engines
- Advanced energy storage and related systems technologies that simultaneously meet competitive requirements such as higher power demand, fast rechargeability, longevity, and low cost are being developed. This program focuses on advanced energy storage technologies which will enable full range electric vehicles to travel at least 200 miles on a single charge. Under the program next generation of nickel metal hydride , lithium ion and lithium polymer battery technologies are being developed and by 2010 700,000 electric vehicles will replace inefficient urban vehicles.
- Efforts are underway to design and develop low cost fuel cells. The US government owns and operates 30 fuel cell co generation units. GM has produced a concept car utilising fuel cell/hybrid propulsion system and promises fuel efficiency of 108 mpg.

Diversification

The above analysis reveals the limited scope of substitution of oil in transport by other energy sources. Alternatively, oil security could be enhanced by diversifying the sources of supply of oil. The Caspian basin is estimated to hold about 30 billion barrels of proven oil deposits but the difficulties of evacuating the crude will limit production in that region. Moreover, bulk of the evacuation of Caspian crude is being planned on westward routes rather than eastward routes to Asia. Large-scale imports from Africa would not be feasible in view of the extra freight costs in comparison to those from the Gulf. The East Asian oil exporters, Malaysia and Indonesia, may well turn into net oil importers themselves by 2010. The analysis, thus, reveals little scope for diversification.

Strategic Petroleum Reserve

An oil shock is typically characterised with actual restriction in availability of wet barrels, coupled with a price rise. While conservation measures in times of crisis, like demand restraint, rationing, etc. are helpful, draw down of strategic reserves is least detrimental for any economy. The announcement of oil release from the reserve actually has an impact on the market long before the oil reaches the refiners. It may be noted that in April 1991, USA decided to release 34 MMT (the actual release was 17 MMT) and the price fell overnight by USD 15/ bbl. With oil prices spiralling northwards this year, in September the US President ordered the release of 30 MMT. The price of the WTI (West Texas Intermediate) which was around USD 37/ bbl at that time, fell to USD 32/ bbl on account of the release decision.

To maximise the impact, the timing of the drawdown has to be right. When a crisis develops, no one knows how high the prices would go and how long they would stay up. Different countries follow different policies regarding stockdraw, some favouring early release followed by demand restraint measures, while some the other way around. USA has been in favour of an early release but was criticised for a delayed release in 1991. This year too critics have pointed out that it is doubtful that the release would have been ordered had it not been for the presidential elections in the USA. For all its merits, therefore, the strategic reserve is a difficult instrument to use.

Releases from the SPR are usually made through auctions and swaps. The price bids reflect the assessments of the marketing companies of the likely movement in international prices and the domestic consumers' capacity to pay. In such a situation, it is not certain that an auction would necessarily produce a price appreciably lower than the prevailing international price. The impact would be even less pronounced in South Asian economies, especially India, which have limited competition in their energy markets. Uncertainties in the outcome of the auctions make the benefits of SPR difficult to quantify. The SPR normally would not be released at a fixed price as there would be no control on the selling price charged by the marketing companies.

Cost of the SPR

The SPR is expensive. The major component of the cost of holding the SPR is the cost of the inventory. This would depend on the level of stockholding and the break-up between crude oil and products. Next, there would be the cost of constructing the storage. The recurring cost would comprise interest and the maintenance cost. The physical apparatus including the underground stores, the pumps and the pipelines need regular inspection to ensure that they work when required. The stock of products may deteriorate in quality if stored for long and it is necessary to renew the stock every three months or so. All this adds up to the cost.

Even if it is assumed that domestic crude production in South Asia in 2010 rises to twice the level in 1997, ninety days import would amount to around 180 million barrels. At the cost of USD 20 per barrel, the cost of the crude will be USD 3.5 billion. The cost of the storage caverns at USD 15/bbl would be USD 2.7 billion. The interest charges and recurring cost of maintenance may amount to USD 300 million annually. A very high cost indeed for an instrument with uncertain benefits. However, the cost could be kept low by building up the reserve gradually over a few years.

Producing more in a crisis

A part of the natural oil reserves may also function as a strategic reserve. This is because the production capacity of oil may be slightly higher than the actual production level. The production level could be kept low on environmental grounds or to optimise reservoir health. In emergencies, such considerations may be waived for short periods and production could be increased. This 'surge capacity' varies from one country to another. However, in India, the largest oil producer in South Asia, the surge capacity is negligible as production is kept at the highest possible level at all times to minimise the need to import oil.

SPR use - Disruption or price rise?

There is some difference of opinion as to whether the strategic reserves are to be used whenever the price of oil rises beyond a point or are they to be used only if there is a disruption in the supply due to war, etc. In the 70s and 80s, the reserves were believed to be an insurance against physical disruptions in supply. However, since oil production today is so diversified that if supplies from one area are disrupted, these can be made up by other producing areas, the reserves are now seen more as insurance against price rise.

Key Issues

- Long-term demand outlook for South Asia indicates a rising share of oil in the primary energy mix. Absolute oil requirements, accordingly, magnify considerably.
- A larger proportion of the oil requirement would have to be imported – imports reaching to about 2 Mb/d by 2010.
- Bulk of the oil is consumed in the transport sector. Any successful substitution policy has to address the transport sector. There are, however, limited possibilities of oil substitution in this sector by other fuels.

- Most of the oil would have to be imported from the Middle East and South Asia's vulnerability to supply disruptions will be high.
- A strategic reserve of 90 days import of crude oil in 2010 would have an estimated capital cost of USD 6 billion and an annual recurring cost of USD 300 million. A part of the reserves may have to be made up of products which would be costlier.
- Strategic reserves are not easy to use. The benefit from their use is uncertain. The decision to go in for SPR should be taken only after adequate research into these questions.
- While oil substitution by gas is most promising, gas imports would be necessary in the future. There has, however, been limited progress on proposals for gas imports via pipelines on account of political differences between India, Pakistan and Bangladesh. While gas imports in the form of LNG are possible, the costs are higher as compared to that via pipelines.
- Power trade in the region, capitalising on the hydro potential in South Asia, though beneficial in the long-run, would have limited impact on oil security.

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Inaugural session

Dr R K Pachauri

Director, TERI

Introduction

We are happy today to have with us Shri Suresh Prabhu, the Honorable Minister for Power. He has suggested that I should make my presentation first and then he will intervene. This is a daunting task, but I will put forward a few ideas to stimulate some discussion during the rest of this workshop.

Let me start by emphasizing that energy security is not to be seen as merely security of physical supply of energy. There is a huge economic dimension to energy security, which has to be considered as well. If you take the case of the global oil market, major oil importing countries are very vulnerable to sudden increases in oil prices, which imply huge economic insecurities. In this country we suffered this in 1973-74, when global oil prices quadrupled. The Indian economy was very badly hit with very serious political implications. An emergency was imposed, which came about because we had an inflation level exceeding 20%. Then came the 1979-80 oil crisis following the Iranian revolution. I am not drawing any connection between the two but the result of that, again, was very serious for the Indian economy. It was one period when the Indian economy actually registered a negative rate of growth. The Gulf war in 1990-91 also created a grave problem. As a matter of fact, in 1991 we were at a stage, when our foreign exchange reserves were extremely precarious. That gave the momentum for reforms in the Indian economy. So a serious crisis also led to a blessing.

Having said this let me turn to my paper which focuses on South Asia, both in terms of energy security concerns and response strategies that we might want to adopt. I would begin with an introduction to present a broad picture of the south Asian energy scenario, energy security concerns and response strategies and then present a few key issues on which we might want to focus discussion.

I have outlined a brief record of major disruptions in world oil supply and as you know there was nothing very serious till 1973-74. Of course, there was a serious crisis in the 50s which caused serious problems for the major oil consuming countries but it was really in 1973-74 when the Arab oil embargo and the Iranian revolution triggered the major crises.

This figure (Annexure 1, Slide 3) shows the physical restriction in the supply of oil in million barrels per day, triggering major price increases. When dealing with the market which is very sensitive to speculation and political developments sometimes even a small imbalance may create a major increase in oil price.

The nature of the oil market is compounded by the reality of the OPEC which is not really a cartel but a price dominant firm, to use economic jargon. In the case of the oil market, that dominant firm is Saudi Arabia. They have a large surplus capacity and if they reduce their production by a million barrels a day, there will be a major impact on prices. If they increased production there would be an impact in the reverse direction. I think Saudi Arabia is in a powerful position to determine what is going to happen in the oil market in terms of prices and quantity.

In defining energy security we should look at a reduction of vulnerability to supply disruptions. This means that there has to be a reduced dependence on oil. If not then there should be an alternative source, immediately available. Now that doesn't really happen in reality because if all your equipment is geared to the use of oil and petroleum products, as with the transport sector, then you are vulnerable and there is no getting away from this. We have to think in terms of a smooth functioning of energy markets. The International Energy Agency has done remarkable work in response to the 1973-74, 1979-80 oil crises. What we really need is a better understanding between producers and consumers, and to minimize environmental damage and promote sustainable development, because energy security cannot be seen isolated from developmental policies.

This gives a picture of oil prices (Annexure 1, Slide 5). If you go back in time though, these was a period of fairly high prices till 1985 which is when they crashed and for a fairly long spell there were pretty low prices going back two years in time when prices actually dropped to about USD ten a barrel. At that stage, if you took the real value, those ten dollars a barrel were less than the price during the 1973-74 oil price shock.

For India and Pakistan, the oil import bill has gone up substantially on account of the recent rally in prices - in India by Rs. 265 billion and for Pakistan by Rs. 33 billion.

Energy scenario in South Asia

Energy demand in South Asia has been increasing at roughly 6% per annum. The role of coal has increased in the energy sector in magnitude, but not in terms of share of total quantity consumed. The figure (Annexure 1, Slide 9) illustrates the current consumption of different fuels in south Asia. Coal is around 49%, hydro is very small, nuclear is barely 1%, gas 12%, the bulk of which is being consumed by Bangladesh and Pakistan and oil is 35%. Coal dominates this region mainly because India is a major consumer with large reserves. So coal is certainly one answer to the energy security problem as far as India is concerned. The issue I would like to highlight about using coal, is the environmental aspect. This is where I think we need a clear technology mission in India, so that we can move towards a cleaner coal technology. In particular the use of IGCC technology for power generation where the coal can be gasified and used in a combined cycle power station.

The figure shows the projected energy mix for south Asia (Annexure 1, Slide 10). In 1997, coal consumption was 49% of the total energy mix. By 2010, coal consumption will actually decrease and by 2020 it will come down even further. Oil is more or less steady but there is a major increase in the share of natural gas. Now here again, we are dependent on several policy initiatives, and possible agreements. The possibility of importing gas for India, which is the largest consumer of energy in the region, from Iran for instance, could alter the picture considerably. Gas imports are also dependent on the kind of infrastructure that can be set up particularly in the transport sector in south Asia. If, for instance we move towards an increased use of CNG then that will pre-suppose an adequate supply of natural gas which will also lead to a reduction in our dependence on oil.

This table shows the resource requirements for south Asia (Annexure 1, Slide 11). An enormous increase is going to take place in the case of coal, in fact, a doubling of demand. For oil, the increase is a result of transportation demands, and gas increases substantially almost five times, compared to current levels. This figure (Annexure 1, Slide 12) shows production capabilities and production levels. For coal, the bulk of the resources is in India, while the largest resources of gas are in Bangladesh, 300 billion cubic metres. There is a large resource which is yet to be discovered and indications are that they would yield substantially larger amounts of gas than this picture indicates. Production levels are also given in the table. India has 359 million tonnes of coal, 33 million tonnes of oil. While for Pakistan there are 43 and 20 million tonnes.

Energy security issues

The bulk of oil production, or 90% of oil production in south Asia, even though it is small in relation to our total demand, takes place in India. As it happens, a large part of our sedimentary basins are yet to be explored. Until the 80s, if you were to take our success ratio in drilling, it was 1:3 which means if you drill 3 holes one will yield oil. That is an unfavourable ratio considering the extent of drilling that has taken place. India by any standards is an under-drilled source of oil. We also have a New Exploration and Licensing Policy (NELP), which will hopefully invite further investment and efforts in exploration. Even so, most geological estimates indicate that India is not a very large repository of oil. Bangladesh has a major programme of exploration in partnership with multinational oil companies. Despite increases in oil production and the likelihood of positive results from exploration, oil imports to south Asia are likely to increase.

The global reserve production ratio is 41 years and this really, is something that one does not have to worry about because more and more discoveries have been made. As prices go up there is an incentive to explore and companies begin to invest on a larger scale. Whenever prices go up, more oil is found. The concern is not so much about the global reserves to production ratio but the fact that the bulk of oil that is going to be found in the future will be confined to a very small geographical area in the Middle East which raises some political questions as well. We are concerned about political instability in that region. We are also concerned about the market power that region may wield as a result. People have predicted a break up of the OPEC in the past, but in actual fact, even if it does breaks it is likely that small group of nations in the Middle East will form a successor to it with a substantial amount of market power.

Reliance on the Persian Gulf has been increasing and this trend is likely to continue in the future, up to 2020 in a manner that will lead to doubling the supply from the Gulf. Supply from other OPEC regions also will increase but not quite as much. But the Persian Gulf will be supplying almost 100% more by 2020. This applies to the world as a whole and not South Asia alone and accurate data on sources in south Asia are confidential. Trade journals do carry this information and they have a fairly good idea of where most of the oil is coming from but official statistics aren't available. Also, countries keep switching sources of supply. The fact that Persian Gulf oil supply will continue to grow in the future, is something with very important political and energy security implications.

These are some bottlenecks, too, not just because of wars or conflict but terrorist actions which could disrupt supply. The Straits of Hormuz, the Straits of Malacca, and the Panama Canal, all are major arteries for the supply of oil, but the largest are the Straits of Hormuz with 15.4 million barrels moving a day. The US Navy has a strong presence in that vicinity to ensure a steady supply.

I might mention however, that the US interest in this region is likely to decline, because it is getting more and more of its supply from the American landmass, from Venezuela and the Caribbean. In the future, US interests will not be guided by the impact of oil on the US economy alone because they have been changing the source of their supply. Now that a Republican administration will take over, drilling activities in Alaska are likely to increase. Earlier during the Clinton-Gore administration, there were restrictions on drilling in Alaska, based upon environmental concerns. But it seems that these have now been lifted to allow the US to produce more oil on its own territory.

The issue that one needs to highlight is our increasing dependence on the Middle East and the susceptibility of the region to turmoil. The sea lanes are relatively secure but for the danger from pirates and terrorists. What is vitally important is the efficacy of the market forces in a crisis. In 1973-74 the Indian response in the short term was quite deliberative. At that stage there were large number of small petroleum-based boilers operating in industry through out India. One of the first things that the Ministry of Petroleum and Natural Gas did was to set up a group to change the fuel in the boilers from oil to coal.

In fact, that was the genesis of what is now called the PCRA (Petroleum Conservation Research Association). All this was only a short-term response. The long term response has been very poor. Even today, the fact is that the share of Indian Railways in traffic movement is going down. Forty years ago, 60% of the traffic in India moved by rail and 40% by road. Today it is the reverse with road transport increasing very rapidly, in fact, I would say, alarmingly. The point made here is that energy policy does not stop with the energy sector, but has to be a part of the overall economic policy. If we are talking about energy security then it is not enough to think in terms of outsourcing the oil from location A or B. We have to have a domestic policy to ensure that the problem of market forces in a crisis does not keep us in a bind.

Response strategies

The transport sector accounts for 53% of the total oil consumption in South Asia, and this is more or less uniformly distributed over all the countries in the region. Any successful substitution policy must address the transport sector, Since our Honourable Minister is present I might mention that we had a National Transport Policy Committee set up in 1980. They submitted a report in 1982. After that several feeble attempts were made to carry out similar exercises all over again. Because the structure of the transport sector has changed substantially, the economy has changed substantially too. The order of foodgrain movement, the quantity of coal moved are all part of a major change.

Unfortunately, there is no transport policy focussed on the future and today that is proving detrimental to the energy security of the country. If we are serious about addressing energy security issues then we have to make a start by developing a vision of what the transport in this country will be like. I imagine that that will be the case with other countries in the region as well.

Railway track electrification is already in progress and the share of oil consumption by the railways is minimal. Because the railways do not provide efficient service there is a shift to road transport. For roadways, battery-operated vehicles would probably be an answer. But we are talking about a shift from oil to electricity which would mean that we need to generate more electricity. This is where I think an integrated energy policy is important. No planning for any sub sector of the energy sector can be carried out in isolation from future trends in transport, industry, etc.

So it is vitally important for the whole effort to be guided by an overall energy perspective even though decisions and implementation arrangements may rest with specific ministries and departments. In India an Energy Policy Committee was set up in the Planning Commission about 5 years ago and I was a member of that. I must say, to my dismay, that we still don't have the final report of that policy committee. This is something terribly wrong that afflicts all the countries of this region. We set up committees but by the time the report is submitted it is outdated. In fact, the whole concept of setting up committees is totally outdated. What you need is a live model, which can be just updated every six months to give a view of what is happening in the energy sector.

In Germany for instance, there are three institutions commissioned by the government to develop models of the energy sector. They get together periodically to tally the results which are discussed and submitted. Judgements can be made at the turn of a key because the expertise is all available. Results and objectives can be quickly attained. The colonial practice of setting up committees to give you policy advice from time to time is obsolete and irrelevant. Firstly, it takes long time for these committees to submit its report. By the time they submit it will be outdated. And then very often action taken on the report is totally inadequate or delayed. In the case of energy security we will have to move to some different form of decision-making with a very different analysis structure wherein this issue gets constant and regular attention.

As I had mentioned earlier India is the largest repository of coal with a high ash content, low calorific value but mercifully very low in sulphur. The environmental impact is thus confined to the generation of fly ash. The coal may be abundant but it is found in small pockets and to move it over long distances to every corner of the country, a massive transport infrastructure is needed. Now coal gasification technology could provide a solution to this problem. If we could gasify the coal then it is entirely possible to move it through a pipeline and use it in another part of the country and as a long-term strategy one could think in terms of natural gas pipelines, and infrastructure using natural gas, which could then also be used for coal gas when coal gas comes commercially viable.

I have already mentioned the problems with domestic coal and that our reliance on imported coal is likely to increase, because people are more likely to take economically viable decisions to set up power plants. Whether it is the electricity board, which is owned by the government or by the private sector it may be financially more beneficial to import coal rather than move it from where it is available domestically.

The international coal market has a certain characteristics - low price volatility and there are only a few large exporters – South Africa, Australia, besides a couple of other countries. The 1990s marked a gradual decline in coal prices largely because of environmental concerns. In Germany for example the use of brown coal has been done away with and there are no more coal-fuelled power plants being built. As the reliance on coal decreases, older coal-based power plants are also being converted. Substitution by gas is a very attractive option and my submission would be, that in order to address energy security concerns over the next 30 or 40 years, our reliance on gas will have to be substantially increased.

But we don't have too much gas ourselves, and will have to get into import arrangements. Perhaps LNG to begin with, but over a period of time as the volume increase we will have to plan for pipelines, and this is an issue that TERI has been very active on for quite some time.

With gas grids one could bring about a shift to natural gas as a fuel in the transport sector. Also, fuel cell technology is likely to be commercialized by 2010 and fuel cells can be run on natural gas. Again we need to have some R & D in our country to ensure that when fuel cell technology becomes available and we are able to adopt it we can build on the generic knowledge that is available and start producing this in our country. If this is not done, there may be a monopoly with one or two manufacturers of fuel cells in the world and that will certainly not be to our advantage.

DME (Di-Methyl Ether) is still in the experimental stages. Recently, an agreement was signed between the Indian Oil Corporation and the Gas

Authority of India with British Petroleum (BP) for setting up a plant to produce DME.

The figure (Annexure 1, Slide 26) gives you a picture of the gas deficits. Even though we produce 50% of the gas that is produced in south Asia, it is very small in relation to its total requirement. This is an extremely gas-thirsty region and I think if we have to address energy security issues in the future this is something that we have to focus on. These are some features in favour of natural gas. The natural gas pipeline from the former Soviet Union to Western Europe was established at the peak of the cold war, and there was never any political doubt about a disruption of supply. It was a commercial arrangement that benefited all the parties concerned. There is no reason why we can't take a similar view and thereby elevate economic issues above political barriers. There has never been any history of supply disruption. The reason is that because the supplier and consumer, both have an equal stake in this arrangement. It is not like the oil market where you can shift the supply sources at will. Prices are bilaterally agreed upon and contractual arrangements are clear and reliable.

The global reserves to production ratio for gas is 62 years but if we start exploring gas and start using it, this 62 years will become 150 years because gas reserves are still relatively unknown. Therefore, shifting the import dependence from oil to gas could enhance the energy security.

We are of course also part of the BIMST-EC discussion. BIMST-EC is a new grouping which includes Bangladesh, India, Myanmar, Sri Lanka, and Thailand. TERI has been involved on behalf of our government in helping with energy co-operation plans as part of this grouping and we have put forward the idea of a gas pipeline which has been discussed in the BIMSTEC meetings.

The graph (Annexure 1, Slide 30) shows some LNG options and what is shown here applies to India. But there is an LNG infrastructure gradually developing. Today this is sub optimal in terms of economic rationale because if we had a gas pipeline supplying the quantities of gas equivalent to the LNG we are now likely to import, the gas pipeline would be a far more economical option.

The Hydrocarbon Vision, 2025, with which I have been associated raises the question of the implications of a shift from indigenous coal to imported gas. Now whether we can pursue this issue is another matter, because it has some political ramifications. Since our demand for indigenous coal and the domestic production of coal are both continuing, I don't see any major conflict here. There are some future gas sources – coal bed methane, and gas hydrates that are still at an early stage of development. In fact I had asked the president of NEDO, this very question because the Japanese are investing a significant amount of money and may be we will hear about this in the session on gas hydrates.

Hydropower still accounts for a very small share of primary energy in this region. We have substantial potential but this again is an area that needs some focus and some international agreements. Of course the problem with hydel projects is well known and there is some power trade between India, Nepal and Bhutan, but this is an area that needs enlargement. Nuclear capacity is still very small, India's target is very ambitious and whether we will achieve it is another matter. There are problems with nuclear power, which don't need to be repeated.

We have a significant reliance on renewable energy and this is an area which can be stepped up. Some figures of our reliance on traditional biomass etc. (Annexure 1, Slide 35). We made some statements on additions to power generating capacity, which I have personally criticized in the media, because I thought it wasn't based on any rational analysis. The costs associated with renewable energy continue to be high and we need major efforts to develop technology.

The renewable energy potential is substantial and we are not tapping even a fraction of it. What we need is an orientation of policy, some reallocation of resources and much greater market orientation in renewable energy efforts, and perhaps integration with power plants wherever possible.

We as an institute have made several interventions working in villages and our experience has been very positive. We are now planning to build on this. It's wrong to believe that rural people will not pay for renewable energy. If it suits them and is beneficial to them they are willing to pay for it.

This is a picture (Annexure 1, Slide 39) of our sustainable habitat of which we are proud. It takes about three hours to visit this. It is a major training complex which we have constructed and our Hon'ble Minister Shri Suresh Prabhu was there at the time of its inauguration by the Prime Minister. I just wanted to draw your attention to one feature over here. Through proper engineering design and architecture, we were able to reduce the demand for energy in this building from 280 kw to about 90 kw and all the demand is now met through renewable energy using photovoltics and biomass gasifiers. We have used many very interesting features in the design which I will not go into but they are listed.

Efficiency improvements are going to be critical in addressing energy security and some comparisons of oil intensities of different countries are presented in this figure (Annexure 1, Slide 40). We are relatively low but certainly not as low as the UK, which uses large amounts of natural gas, some coal and some nuclear energy.

We need to diversify our supply to the Caspian resources, West Africa, and Southeast Asia. Indonesia and Malaysia are however, likely to become net importers of oil over the next few years.

Strategic stocks are advantageous compared to demand restraint measures as stocks can be used immediately and we need to have an emergency strategic petroleum reserve programme. Stocks can be used immediately, they give relief and minimise economic impacts and are less disruptive. Their impact on prices is also measurable. In 1991, prices came down to $ 15 per barrel from $32-37 dollar per barrel, when President Clinton authorised the release of oil from the strategic petroleum reserve. The timing of the relief is critical.

If done too late then the impact could be minimised. So you have got to anticipate and take action immediately to impact the prices.

Summary

The key issues in South Asia are thus, the large oil requirements over the next two decades, a large proportion of which will be imported reaching about 2 million barrels per day by the year 2010. In addition, South Asia's dependence on the Middle East will continue to be high and institutional problems remain in the energy trade in south Asia, which I hope we will discuss in greater detail. The role of indigenous resources is important in enhancing energy security but there are questions about how much coal you can move to different locations. Tapping the region for hydro potential is important while taking into consideration the environmental concern. Where efficiency improvements in renewable energy technologies are concerned, there are some constraints which can only be removed through further research and development efforts.

Thank you.

Inaugural address

Hon'ble Minister for Power - Shri Suresh Prabhu

Energy security can play a very important role in solving many other problems. Changing life styles in this region have really brought these issues to the forefront.

Once upon a time villages were self-sufficient and the energy requirements of mankind were different. Dr Pachauri pointed out that the energy requirements would triple in the next 20-25 years. But suppose, you were living a different life style. The energy requirements then would also be different. Having decided to pursue a life style of the developed world, we have no other choice but to follow a path of increased use of energy. So one of the ways of looking at energy security, is to think in terms of a lifestyle different from that of the developed world. This would reduce the energy requirement.

Since I am responsible for power generation in the country, I am always confronted with the question of per capita consumption energy in India being one of the lowest in the world. What is the choice? To increase the per capita of consumption of electricity and bring it to the world's standard would imply that we multiply our per capita consumption by one billion people and that would be the electricity generation required from hydro, thermal, nuclear and renewable sources.

The choice for the people in this region is to either adopt a low energy path or increase energy production. This choice has to be made by the people themselves and not the government, because governments are normally guided by the lifestyle of the society and act as agents of it. The is particularly true in a democratic set up.

If we consider the option of importing oil we need to evaluate the risk associated with it and ask ourselves to what extent are we willing to take the risk. In a few years from now, our energy requirements will be so high that they would necessitate an increasing dependence on oil imports. The impact of this on the economy of the region needs to be carefully examined, because clearly high levels of imports will not only affect the energy sector, but other sectors of the economy as well.

It is not just the security of transit and sea lanes for bringing the oil into the region, but also the impact on the total import bill that will be substantial. This could have a further negative impact on the value of the currency. A depreciation in currency as a result of a large import bill will definitely affect the lifestyles of people adversely, because high import dependence on one commodity will exert a pressure on the currency and make other imports dearer as well. Other associated drawbacks of this would be lack of export competitiveness. So in the process increasing energy consumption to improve the quality of life, we may actually cause a deterioration in its quality.

I thought I would also mention that one way that we are all thinking of addressing this problem is through deregulation and opening up of markets. We are trying to open up the market to meet the energy challenge in a more efficient way. But we need to understand what the challenge is. Our main challenge is from the oil markets, which are probably the most controlled of any markets in the world.

The issue is, how can we deregulate the market which is controlled by OPEC? In the modern day world, where oil dominates the world economy and the whole of the world is thinking about deregulation of all commodities, services, and agricultural products, how can we allow a cartel to dominate the world economy? While the WTO and other trade organisations cannot address these issues, a mechanism would need to be developed to address this issue.

Can we not think about the development of new technologies, and bringing the countries in the region together to think about our common interests? Can this not be the response to the influence that OPEC on the oil market? If we look at OPEC's constitution, it has member countries located in Latin America, Africa, and in Asia, and have managed to unite despite the fact that they have very little in common. Apart from the geographical proximity in South Asia, the countries in this region have many interests in common and I am sure when we sit down to discuss these issues we will discover many other commonalties as well.

Gas pipelines, for instance, is one area of common interest. Ancient civilisations flourished near water all over the world. In modern times, civilisations will develop around pipelines. Economic development will take place near gas pipelines. If you take India for example, all petroleum complexes are going to be developed alongside pipelines. Probably Mr Vikram Singh would tell us why only pipelines and not gas terminals. So probably gas terminals could also be the one of the other centres of development. But gas pipelines must definitely be an area for future co-operation in the region.

It is also possible that because of the huge scale of operation, we could also co-operate in developing mega projects in hydro and gas based power plants and petro chemical complexes. These are areas in which we can all come together so that the energy problem can also be looked at as a possible area for co-operation. In addition, if we keep identifying areas of commonality, tensions within the region can also be reduced dramatically.

One other area on which I think we must concentrate particularly in the South Asian region, is the development of renewable energy sources. The countries in our region are very quick at providing intellectual responses but unfortunately we are not as good with institutionalising the response and implementing it through a proper forum. Dr Pachauri gave interesting figures about the decline in power consumption in the UK since 1974 and yesterday he was telling me that Japan took several steps to respond to the oil crisis in 1974. Since then they have institutionalised several reforms and modernised their industry to reduce energy consumption at various levels. But in this region our responses are usually in the form of protests and as protests die, so does the response. Given the tremendous potential for solar, hydro, wind, and tidal energy, we need to develop a co-operative response strategy utilising these resources.

About 52% of oil imports are used primarily for transport sector in the region, and that brings us back to the point that I made regarding changing lifestyles. If we are going to increase the number of cars owned per family, then we would obviously need much greater oil imports as well. In this respect, I think the sociologists may have an important role to play. The other response mechanism could include a competitive pricing policy for the transport sector. One of the reasons why the railways carry less goods than road transport in India is because today rail traffic is more expensive than road transport and is also less efficient than road transportation. A new pricing policy can be brought about through market based instruments which will help reduce the oil consumption in the transport sector.

Modern technology in transport also plays a very important role. Diversion of traffic from road to other forms would also be necessary. Probably using inland waterways could be one alternative, which again offers a tremendous potential for co-operation with Bangladesh for example, but which has not been explored at all.

In India we are currently planning to increase hydro capacity in the next 10 to 12 years, the potential for which is estimated at 1,50,000 MW. One of the apprehensions raised in this regard is the aspect of ecological security, which cannot be thought of in isolation when contemplating energy security. As Dr Pachauri has ably pointed out, energy security issues go much beyond the energy sector itself. Therefore all other sectors will have to be mainstreamed into considerations of energy-based issues. Ecology will be an important part of that consideration. Therefore, whenever we think of development of the hydro potential, ecological issues come to the forefront. But then, we must also accept the fact that any intervention made by humans is bound to cause some damage to ecology. The only choice we have is to reduce the damage. We cannot eliminate it altogether.

If we really look at the development of hydro potential in relation to the development of the hydrocarbon sectors, hydro would probably be less damaging. In any case, from the standpoint of energy security this could be the best option because it is domestically available and does not involve the vagaries of import, has no impact on domestic exchange rates, in addition to being a non-exhaustible source. Again, from the standpoint of energy security, we need to analyse how long our water resources are going to last. However, utilising hydro potential for generating energy has the advantage of not consuming the resource actually, which can be used for other purposes. Dr Pachauri has pointed out that Nepal and Bhutan are going to generate power, which will be used by India, and a part of the power generated will also be used domestically. We are now exploring the possibility of tapping a potential, which would go much beyond 1,50,000 MW as a result of the available potential in Nepal and Bhutan. In any case, Nepal and Bhutan, may not have the demand for the electricity that can be generated using the hydro potential and the surplus can easily be supplied to India.

In the case of Bangladesh there is a possibility of using the gas, generating the power there, bringing a part of the power to India, and part being used by Bangladesh, so that economies of scale can also be achieved. These opportunities will go beyond the energy sector and will transcend into many other interesting areas of mutual co-operation and can probably reduce the cost of security. Both intellectual and physical energies can be saved by exploring these opportunities. I must sincerely congratulate Dr Pachauri for bringing all of you to India to facilitate this process.

With this I welcome all of you on behalf of the Government of India. I will look forward to the recommendations from today's deliberations and I assure you that our response will be very prompt. Thank you very much.

Vote of thanks

Mr Ardhendu Sen, Senior Fellow

To conclude the inaugural session I would like to take a few minutes to propose a vote of thanks. First of all thanks to our Hon'ble Minister Mr Suresh Prabhu for being with us this morning. The Power ministry is the nodal one in the Government of India for formulation of its energy policy. And his participation in the conference is obviously extremely important for us. While welcoming all the delegates to the conference I would like to acknowledge the presence of the overseas participants.

Two years ago we had a similar seminar on energy security but at that time perhaps we had an academic discussion. But the price-rise over 1999-2000 has really driven home the point that we still do not understand the energy market especially the oil market, which we are not able to control. In order to keep the oil prices confined to the bandwidth, which is acceptable to producers and consumers alike. I am sure we will be visited by a similar price volatility in the future also. Unfortunately the fact remains that these fluctuations hurt developing countries more than others. So we thought there is a need to restate the problem and the time is appropriate that we do it and that is what we propose to do today. The other theme that we wanted to discuss today is regional co-operation, which we all believe is absolutely necessary in order to reduce the cost of response strategies.

We feel greatly encouraged by your participation and presence here and we hope to learn much from the deliberations of the day. Thank you.

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Global energy security concerns

Dr. Hoesung Lee

Chairperson

President, Council on Energy & Environment, Korea

I am from South Korea and one of the think tanks in energy and environment policy. As you know this session is about the concerns about energy security and developing a response strategy to this issue. In this session, we will try to touch upon energy security issues that are of concern. It is important to think through the nature of the concerns in energy security. We want to be somewhat sure that are we concerned about price uncertainty or supply uncertainty or both? In other words, are we concerned more about price uncertainties or are we concerned more about sustainable supplies.

The more precisely we define the nature of concerns, I think, the better chance we have of enhancing security. We also heard from Dr Pachauri and also the Minister of Power that the oil market has changed. In the old days, when the two previous energy crises occurred, 80% of oil was sold to OECD countries. Oil is becoming more and more precious. Such issues are to be looked into and deliberated in this session. Are we more concerned about preventing a future oil crisis and energy security issues? Are we more concerned about living with it at a more reasonable cost? There are many problems and uncertainties in this world and energy markets in this globalising economy. There are more challenges and we are happy to live with it. We have to adjust to the reasonable cost in this economy. I think a good example for this is the stock market. Stock markets are highly vulnerable. But we learn to live with it aim to prevent vulnerability in the stock market.

We have very distinguished panel this morning Mr. Masuda – Director, International Energy Agency.

Mr T Masuda

Director- International Energy Agency

"Concerns for Oil Producing and Consuming Countries"

Good morning and thank you very much for your kind introduction. First of all I would like to express my sincere gratitude to TERI and people of this country. I hope this country will very quickly recover from this oil crisis.

I am very happy to be here again as I came to India in January 1999, to the first of its kind security meeting. And I to note the remarks made by Mr Ardhendu Sen in his vote of thanks, that three years ago we discussed this from an academic point of view. But today we will be talking on some real issues for concrete solution.

World Oil/Energy Outlook to 2020

The latest "World Energy Outlook to 2020" made by the International Energy Agency (IEA) in November 2000 projects that total primary energy demand will increase by 57% between 1997 and 2020, at an average annual rate of 2%. This is based on the assumption that global economic growth will be more than 3% per year. It predicts that the reliance on imported oil and natural gas of the main consuming regions, including OECD and dynamic Asian economies, will increase substantially. Oil will remain the dominant fuel in the primary energy mix, with a share of 40% in 2020, as a result of 1.9% annual growth. The transport sector will be the most important sector of oil consumption. In OECD countries, this sector accounts for all demand increase in oil. In non-OECD regions, transportation accounts for most of the growth in oil demand, but the household, industry and power-generation sectors also contribute.

As widely perceived, natural gas demand will rise much faster than oil, at 2.7% per annum, increasing its share in world primary energy demand from 22% in 1997 to 26% in 2020. Natural gas use is expected to surpass coal use after 2010. Its much lower content in carbon and other pollutants compared to coal and oil contributes to its attractiveness to those concerned about climate change.

Coal demand will increase by 1.7% a year, slower than total primary energy demand, and its share will decline from 26% in 1997 to 24% in 2020. China and India, with ample coal reserves and strong electricity demand-growth, are expected to contribute to more than two-thirds of the increase in world coal demand.

Oil Security Concerns: Focus on Asia

The world oil balance to 2020 shows that Asian demand (including Japan and Korea) will surpass that of North America well before 2020. Until today, North America has recorded by far the largest oil demand.

One element which requires special attention is regional oil import dependence. Import dependency will increase across the major consuming regions towards 2020, making even North America 58% dependent on imported oil. In terms of supply sources, North America and Europe will secure multiple sources, on top of indigenous supply, ranging from Latin America, Africa, Russia, the Caspian area to the Middle East. Contrary to this, Asia will be increasingly dependent on supplies from the Middle East, while Asian oil production is mature and expected to fall over the next two decades. Indian import dependency is expected to increase to 85% in 2010 and to 92% in 2020. Most of the oil will flow from the Middle East (and part of Africa), which will become increasingly a natural supplier to Asia. A report "*Global Trends 2015*", published by the National Intelligence Council of the United States in December 2000, predicts that only one-tenth of Persian Gulf oil will be directed to Western markets and three-quarters will go to Asia by 2015. Saudi Arabia, for example, already ships about 65% of its total oil exports to Asia.

It could be argued if increased oil import dependency necessarily leads to increased insecurity. It may depend on the mode of imports. If a region is favored with multiple supply sources, the possibility of supply disruptions will be much smaller. If a region relies on supply from a single region, the story may be different. Conventional wisdom is that there will be no politically motivated actions to disrupt oil supply significantly. However, the recent experience is that Iraqi oil exports of 2.3 mb/d had completely stopped for several weeks from 1 December 2000. The impact of this disruption on the market could have been very serious if it had happened three months earlier.

Disruptions could arise as a result of an accident or military actions, as shown by recent history. Geographically, there are chokepoints for seaborne transport of oil, which require special attention of policy makers: the Strait of Hormuz and the Straits of Malacca, for example. As I said earlier, the traffic of crude/product tankers between the Middle East and Asia will increase dramatically as years go by, which will add renewed vulnerability to the supply security of Asia.

New threat to oil supply infrastructure

A possibility of computer failure and cyber terrorism was much discussed before and after the Y2K roll-over. The IEA made constant efforts to minimise this possibility and was on the alert with Member Governments, major oil companies and international organisations to respond to any problems. In fact, oil/energy supply infrastructures are heavily dependent on computer networks as are other infrastructures. "The Next World War", a book written by James Adames in 1998, focuses on cyber attacks and warfare. If there were effective cyber attacks against the oil/energy supply infrastructures, they would be very rapid and invisible, requiring the IEA to have more rapid responses than to traditional disruptions. The use of weapons of mass destruction is another area which needs attention from a security perspective. As "*Global Trends 2015*" points out, chemical and biological weapons are easier to develop, hide and deploy than nuclear weapons. To think the unthinkable is part of my oil security business in the IEA.

The IEA's emergency response capability

Since its establishment in November 1974, the IEA has successfully developed its energy response systems and capabilities. Its Members has increased from 16 to 25 as of today, with a strong likelihood that Korea will join the IEA shortly. Members have rights and obligations stipulated in an international treaty, "Agreement on an International Energy Program". Its essence is co-ordination of oil emergency responses, with sharing-of-oil among Members in a serious disruption. Under this treaty, net importing countries have obligations to keep oil stocks equivalent to 90 days of net imports of the previous calendar year. At present, one-third of some 3 billion barrels of stocks is government/agency-owned stocks, and the rest is owned by the industry. The maximum drawdown rate of IEA stocks held by governments/agencies is as much as 12 million barrels per day in the first month and around 8 million barrels per day in the following two months.

The IEA is equipped with other emergency response measures: demand restraint, fuel switching and oil surge production. IEA Member countries have statutory powers to initiate demand restraint measures.

The strength of today's response capability lies within its solid, yet flexible structure and operations. Furthermore, the IEA has a complementary set of measures known as "Co-ordinated Emergency Response Measures" (CERM). This provides a rapid and flexible system to respond to actual or imminent oil supply disruptions. During the Gulf Crisis of 1990/91, the IEA prepared and activated a contingency plan to make available 2.5 million barrels per day of oil to the market under CERM. In 1999, the IEA prepared for possible supply disruptions due to Y2K computer problems by putting a 2.0 million barrels per day contingency plan on the shelf. When the oil supply/demand became very tight and possible shortages of heating oil were anticipated in late 2000, the IEA prepared itself to respond to regional shortages of oil products especially of heating oil.

To ensure that its systems and measures are in a high state of readiness, the IEA conducts exercises from time to time using various scenarios, including real-time scenarios. In 1999, representatives from Member and Candidate countries (Korea, Poland and the Slovak Republic) as well as major oil companies participated in a 'war-game'-type disruption simulation exercise.

The IEA's role towards global energy security

An important factor in assuring the future of oil security is the impact of oil demand increase in non-IEA countries outpacing IEA Members. Demand growth in IEA countries is expected to be less than 1% per year in the next two decades, while it should be over 3% in the rest of the world. Therefore, the effect of IEA emergency responses will diminish as IEA's share in total oil demand declines.

A series of events in 2000 reminded us that this global community can not ensure a sustainable development without proper insurance on oil security. It is dreadful to imagine how badly the global economy would have been damaged without this insurance if there had been a serious oil supply disruption last autumn, the time OPEC spare production capacity had slimmed to a historically low level of just above 2 million barrels per day. The IEA double-checked its Members' emergency preparedness, and was ready to act at any time necessary. Oil is the dominant source of primary energy supply, and the largest commodity traded internationally. The year 2000 was the first year in the last two decades when public protests against soaring oil product prices put oil issues high on the social and political agenda in many countries, not only in Europe. It awakened policy makers to the importance of oil security.

Before long non-IEA countries will be the dominant oil consumer. Thus, it would be sensible to consider the extension of the IEA concept to other countries in one way or another, and the co-ordination of the IEA emergency responses with those of other countries and regions.

Already, efforts have been underway between IEA Member countries and non-IEA countries, which is one of the major pillars of IEA activities in recent years. The following are examples of those efforts:

Oct. 1996	IEA-China Memorandum of Policy Understandings in the Field of Energy
April 1998	IEA-India Declaration of Co-operation in the Field of Energy
June 1998	IEA-Brazil Workshop on Enhancing Oil Sector Energy Security (in Rio de Janeiro)
May 2000	IEA-ASCOPE Asian Oil and Energy Security Seminar (in Kuala Lumpur)

In parallel with co-operation with oil consuming countries as above, the IEA is taking initiatives to increase the transparency of the oil market in close co-operation with various international organisations including the OPEC Secretariat. The oil market is large, dynamic and complex. Oil market data available today needs to be further improved in order to provide policy makers and market players with a better picture of dynamic market developments. For example, there is no authoritative information on oil stocks outside of OECD (e.g. Caribbean area). Also, it is extremely difficult to have access to timely and accurate oil demand data of non-OECD regions.

In this regard, the IEA hosted the International Meeting on Oil Statistics on 13 and 14 November 2000. It was just before the 7th International Energy Forum held in Riyadh on 17-19 November 2000, which identified the quest for a greater oil market transparency as a priority for producer/consumer co-operation. The First Oil Statistics Meeting was attended by OPEC, APERC, OLADE, EU (Statistics) and UN (Statistics). The 2nd Meeting will be held in early April 2001 in Asia, probably in Bangkok.

Way forward: one-stage-up

The concept of energy security has evolved over years, and it is no longer limited to a narrow definition of oil security. It now encompasses issues as wide as sustainable development, the energy dimension of climate change, natural gas and electricity security, market deregulation and liberalisation. Nonetheless, oil security remains the core of energy security, which was highlighted due to recent developments in the oil market. In this regard, the importance of emergency oil stocks cannot be stressed more as the most effective insurance, proven by IEA experience. I believe the time is ripe to move to the next stage of co-operation between the IEA and non-Member countries from the level of just sharing experiences. The IEA Ministerial Meeting in May 2001 will highlight the need and readiness for increased co-operation. A few years ago, I proposed "Asian Joint Stocks" for ASEAN countries as an option to hold emergency stocks in most cost-effective manner. APERC's report on "*Emergency Oil Stocks and Energy Security*", published in 2000, incorporated this idea as an option for smaller Asian economies. This is, indeed, a concrete step forward. Co-operation with Korea has advanced well, and it is more likely that the fourth largest oil importing country will join the IEA this year. Korea currently owns about 90-days of oil stocks by the IEA definitions.

China-IEA co-operation is moving to a more concrete stage in the area of stockpiling. In the April, the IEA and China will hold a two-day joint Workshop on Emergency Oil Stock Issues at IEA headquarters. The Chinese team will be lead by the State Development Planning Commission (SDPC).

India is one of the big players in the global oil market, with growing demand and increasing dependency on imported oil. The Workshop held today, I believe, will mark another concrete step forward for South Asia for greater oil/energy security. The IEA will walk with you and work with you in this important area.

Lt. Gen. V.R. Raghavan

Director-Delhi Policy Group

Ladies and gentlemen, it is a special privilege being here. I would concentrate on the military dimension of security. We have heard about the rising demand and about the convincing argument of very heavy, almost overwhelming dependence, on the Middle East. It is estimated that 95 % of Gulf exports would be to East Asia. On the other hand, I wish to draw your attention to how the major power US has attempted to go about the problem of oil security. In a book called "Pacific Defence: Arms, Energy and America's future in Asia", the author calculates that oil imports dependency will rise from 54% to 75% by 2010. But the fact is that the major power looks at this huge dependency as a clear security vulnerability. So what does it do? The congress passes a US Energy Security Act. And the Congress demands from the government that this dependency must be reduced to 50% by 2010. And the Secretary of Defence would be accountable to the Congress for this reduction. So that's the military dimension of energy security.

In terms of oil prices itself, a Department of Energy's assessment I have makes interesting reading. For maintaining uninterrupted flow of oil from the

Gulf region, the cost of US military and foreign aid program in the Gulf area from 1980 to 1990 was as high as 365 billion dollars. And the conclusion is when military and energy security factors are taken into consideration, the true cost of oil is as high as 100 dollars per barrel. So which costs are we computing. And this doesn't take into consideration the cost of actual military action to defend our interests in the Persian Gulf and it goes on to Gulf war and things like that. With that background the Indian position and the East Asian position becomes important.

In the first presentation we heard about choke points. Navies all over the world use the phrase called SLOC - Sea Lanes of Communications. Indonesia is there which is a key player. India is also there. And there are other states, which are also interested in choke points and sea-lanes of communication. If one analyses the manner in which naval hardware is being acquired in West Asia, the talk about blue water navies, power projection across oceans, the number of giant naval exercises being conducted in the region, the importance of sea-lane communication and choke points emerges. If one looks at the media debate in countries like Korea, Japan, Indonesia, Singapore, the references to naval capability in relation to energy security in terms of assured flow is unmistakable.

And the future is perhaps indicated by the past. We remember tank wars between Iran and Iraq. We now know what happens in South China Seas in terms of EEZ (Exclusive Economic Zone) of 200 miles and Chinese claims on islands which are energy rich and the stand taken by Philippines and Vietnam on Chinese positions. There is very clear effort by the ASEAN regional forum to defuse the tension and see if it is possible to demilitarize the area, primarily from the energy point of view. The Petroleum Economist, one of the well known journals in an issue wrote, if no movement is made towards resolving these disputes, military conflicts may continue to escalate possibly leading to involvement of major powers to protect international trade routes.

And yet co-operation and collaboration, which is the route to solve these issues, suffers serious impediments. Our main speaker in this session spoke about Korea. One assessment is that the Korea-Japan co-operation on getting energy from Far Eastern Russia is the perfect answer to the problem in that area. And yet Japanese-Koreans suspicions about each other blocks that. We have Bangladesh-India in the subcontinent. The logic and economics is absolutely clear. Political reasons on both sides of the borders and creates its own dynamics in holding back this kind of co-operation and collaboration. And political leadership does not make co-operation very easy either. Indian hopes of getting gas from Iran through Pakistan for example - the logic of it is infallible.

Dr Pachauri and TERI have been pushing for this pipeline to come through. And yet Indian establishments feel very insecure and looking at this as possible. Why does this happen? Because I think political leadership, notwithstanding the fact that the conference was inaugurated by a young and bright politician this morning, have huge fears and the statements don't match their action.

Let me quote from a speech given to the Pakistan Institute of International Affairs by Gen. Musharaff. This is no critique of him. He is looking at issues from strategic point of view. But statements create huge fears. And that's the dilemma of safeguarding your interests if wanting to collaborate. I read a part of the speech. He is talking about Pakistan's foreign policy. And quite rightly he says "...one of the determinants is the economic interest of Pakistan. Gas is emerging as another area of economic interest. Qatar wants gas to be sent to India, which has to go through Pakistan. Iran wants to send gas to India, it has to come through Pakistan. In all these, Pakistan is a focus. God has given us this strategic location. The importance of which is emerging fully now. The route of gas in all proposals to India is through Pakistan. The hub is Pakistan and so this is the ground reality. And therefore our foreign policy will be guided by this."

At one level it is perfectly legitimate. A perfectly valid statement from the Pakistani point of view. From another point of view it creates huge anxiety. So you see co-operation is fine but there are huge stumbling blocks to it. And certainly South Asia and East Asia is loaded with these obstacles. And that is why the military dimension needs to be watched very carefully.

Finally, energy, it seems, might become a catalyst for separate standards. The Indonesian example is one. India 's north East is another. India's oils flows from NorthEast come through a narrow bottleneck. So whether it is terrorists driven or irrational followers driven or any other such factor, the vulnerability to energy flow will become high. Tanker piracy - today if tanker piracy takes place, the navies of the world, would have no time in imports. They all would have all on high seas to make sure that this doesn't happen. A very chaotic situation. And our chairperson today talked about weapons of mass destruction also. It doesn't require a nuclear power to do it. It only requires an irrational small group to do a suitcase job. Under the circumstances, what is my perception of how things are going to go. If energy resources are geographically centred and global dependency on them is high, the only way out would be collaboration and co-operation of kinds, which transcends ideology, which transcends trans-border disagreements. And that is the global energy architecture, which in my opinion should come. And I would like to see that day when both IEA and others initiate action towards that kind of collaboration. Thank you.

Mr Vikram Singh Mehta

Chairman, Shell India

I think all the issues have been identified and most of conclusions that have been stated cannot be contested. Those are the issues and conclusions I would support. In thinking about my comments today, I don't wish to repeat what others have already said. Perhaps just place into wider perspectives some of the statements that have been made. I really wanted to just talk about three particular issues. One is price, the other is structure and the third is option.

Clearly price is our great concern when we talk about energy security. Today the price of oil is running at levels that many countries in this part of the world cannot afford. I make this point while seeing that the long run price of oil will tend towards the long-term marginal cost of producing oil from non OPEC countries. And that would be within the band of about 14 dollars to 20 dollars a barrel, so significantly low than what we see today.

You might well ask what is long run and that will we go bankrupt before we reach that long run? And my answer to that is that long run is not so long that we are all dead. It is indeed in the foreseeable future. The reason I make this assertion is because the price of oil is ultimately market determined - it is ultimately the result of demand and supply. There is no doubt that there is a very strong political element to it. There is no doubt the Middle East, the OPEC factor is the reason for the volatility. And there is no doubt, that we will continue to see volatility in the price of oil. But having said that, I think in discussing this issue of energy for the sub continent, we must not loose sight of the underlying fundamentals - demand and supply.

Let us look at demand and supply in a little bit more detail. On the demand side, as the main speaker mentioned, there is growth of demand across the globe. But the rate of growth of demand in the western world has reached a plateau. Indeed in some countries it is declining. When you look at the Far East, you find you can divide Far East economies also in three broad categories. You can look at Australia and New Zealand in one category, where the demand has reached a plateau or is on a decline. You can look at Korea, Malaysia, Thailand, Hong Kong, etc. where demand is growing, but it is not growing at the rate that we would consider explosive. And indeed as their economies pick up once again and they begin to introduce new technologies which they have, those demand rates is going to slow down and plateau as well. Then there is third category that is India, China, and Indonesia - the three countries where we must anticipate explosive growth.

Now on the supply side, OPEC can be really broken into two broad categories as well. Or may be three. You have a group of countries in the Gulf with high reserves and low absorptive capacity. They have very low absorptive capacity for investing or absorbing revenues that they might generate through export of oil in their own economies. While the other extreme countries are those that are already producing and have already reached the capacity level. They are producing at their capacity and cannot produce more, however high the demand grows. And then you have others in between those two categories, Iran and Iraq, countries with high reserves and high domestic absorptive capacities.

The particular domestic policy of each of these groups is very different. This is one reason why we actually don't see OPEC functioning as a unified cartel. There is no doubt today in the last few months they have indeed shown a degree of the discipline that I had not anticipated. And they have indeed managed to control the price. But looking ahead, again one must anticipate that those countries in the Gulf with high reserves of oil but very low domestic absorptive capacity, will have interests in ensuring they can secure markets of India, China and Indonesia.

So when you combine that supply factor with the demand equation that I have just painted, the picture where we begin to see an inter-dependence, that puts perhaps security issues in a slightly different light. There is no doubt again, Middle East is a politically vulnerable environment. Anything can happen there, but the question that I posed to myself, will we see a repeat of the kind of nationalism that we saw in the 60s and 70s? They were politically motivated and embargoed in 60s and 70s - this is because of isolated events that were not necessarily driven for achieving political gain. The consequence of regional disturbance. We need to guard against that later event.

The second point I have is regarding structure of the industry. Over the last 2-3 years we had seen radical transformation in the structure of oil industry. On one extreme mega mergers where Mobil Exxon, BP Amoco, and bunch of others, have created these super majors that have huge resources. The turnover of these companies is more than the turnover of 70 % of the countries in the world today. That's one set of companies. Only a hand-full of such companies. At the other end of the spectrum you now see niche players - companies that have decided to focus in very narrow spectrum of that oil gas value chain. They have decided to be either specialist refiners or specialists marketers even in the market area - specialists' retailers and of particular product. Or they have decided to be in the upstream area.

In the middle of this spectrum our companies are struggling to find a place. They are also going to move towards or they are going to be swallowed up by one of these majors. Or are they going to actually have to become specialists and niche players themselves. But the point I am trying to make is this radical restructuring in oil industry has created a group of companies that have now resources and leverages to begin to talk on economic basis. This is where the governments and multilateral agencies create the sort of capital intensive options that sub continent like ours need in order to become more energy self sufficient.

We talk about Iran to India gas pipeline and the Bangladesh to India pipeline. We talk about the hydro electric potential in Nepal. These are all issues requiring huge capital. There is no point in talking about them in isolation. And the Governments that we are that we are talking about are essentially those without financial resources. Though India has substantial foreign exchange resources, it does not have a healthy fiscal position. How can we talk about these options unless we actually also address the entire issue of financing? When we do discuss these issues then we have to discuss the partnerships that are required in order to bring some of these option to reality.

Pakistan may believe that it is sitting at the harbour of a strategic network. But if it starts to ask for 700 million dollars or what ever figure I keep hearing about, to bring the pipeline from Iran to India, there is not a single company that is going to pay them. And therefore that project is not going to happen. The government to government deals of this nature are not necessarily going to happen. Because government to government deals are profuse with bureaucracies, forget about the political will. What we are really looking at now is trying to create a forum on an institutional basis by governments, multilateral agencies and private companies, to broke together trans-national projects. Such projects create energy options that begin to reduce some of the exposure of these countries towards imported energy and basically overcome the political hurdles.

Finally, of course, we must never ignore role of technology. In the energy business, technology has shown that we can to reduce costs significantly. We have found oil where we do not think oil existed. In fact, we have found oil at numbers or economics that we frankly could have never anticipated. Technology is going to create new frontiers and it is technology that will also create inter-dependence. So in a connected global world, energy security is not an issue that really is our concern. To me the real concern is how do we create options? We have got to move forward now and pragmatically exploit and harness the resources that we do have in the sub continent. We have to go beyond just talking about the politics, we have to see if there is practical or pragmatic way by which we can monetise the user. We have to place proposals on the table and given the state of their economy and the state of their public exchequer, governments cannot afford to ignore these proposals. That is why forums like these are very useful. You see around here private enterprises, public enterprises, agencies and, of course, the government. It is this sort of forum that needs to draw up the agenda and then lobby with various governments to push it forward. Thank You.

Chairperson's remarks

Thank you very much. We have very limited time. Mr Mehta has talked about the fundamental market aspect and Gen Raghavan talked about the non-marketing aspects of the energy security. IEA Director, Mr Masuda, talked about the governmental concern of the energy security issues. With this background information, I now open the floor for the discussion.

Question & Answer Session

***Question:** I have a question for Mr Masuda. One of the issues that seems to have figured quite promptly is the recent debate particularly both in France and in UK when oil prices went up. The fact that government themselves were trying to take advantage of the price increase in increasing their own revenues substantially. So effectively one of the contradictions, is that government see oil imports as an important source of revenue. I think this is also equally true in the case of India. One of the problems is how best to reconcile this domestically. What is the view of the IEA on this particular?*

***Answer:** I think you are quite right. The reason why many European truckers and agricultural people protested against their governments for soaring prices, was not because of OPEC action, but because of the high percentages of taxes on oil products like diesel and gasoline. Actually, the average tax proportion for the IEA member countries on gasoline is roughly 60 %. In UK and France, it is the highest and is close to 70 to 80%. In US, however, it is very low and ranges between 10 – 15 %, but the average is 60%.*

We discussed internally the best approach to this issue as OPEC is challenging us on this. We have to decrease tax proportions if you like to see oil prices lower, because OPEC has done everything that they could have. But we have not yet reached any conclusion between IEA members on decreasing the *proportion of tax on oil products. It has various hurdles and is a long term policy process. High taxes really serve as an incentive for energy users to save more, decrease the growth rate in energy consumption and increase efficiency in energy use. We believe that the tax policies on energy are all right and that we are not in the position to change the tax portion on oil products to a great extent, even though the pressure from OPEC for doing so is high.*

Question: *Could I ask related question to Dr. Masuda. The US decision to dip into the strategic petroleum reserve was criticised on two grounds. Basically some people say that the timing was on political grounds and that it did not serve the objective of bringing down oil prices. Could the IEA have any views on this?*

Answer: *This was actually what we call a non-market intervention by oil consuming countries. The US government drew down 30 millions barrel of oil in a month. Roughly one million barrels per day of extra supply was released in to the market over a month. And our conclusion was that it served the hidden interests of the US government, i.e., to suppress the oil prices. It succeeded to some extent and the oil price was eased from September to the end of December. Interestingly even some OPEC countries had welcomed this approach. It was a good approach to ease the tension in the market and we welcome US initiatives as these serve as a challenge to OPEC's existence.*

There are discussions amongst IEA member countries regarding using our emergency stocks to influence prices, without any serious physical supply disruptions. Some member countries in European Union like Spain were very keen on this approach. Most of the IEA members are, however, cautious as such measures essentially constitute market manipulation, which is exactly what the OPEC is doing. Additionally, if we use stocks for price manipulation, the move could be reacted to fiercely by OPEC countries. Finally, if we do that often the emergency stocks will get depleted and we may not have enough capacity to respond to real supply disruptions. While debates are still on going on this issue, I personally think that the conclusion will be negative.

Comment: My comment would be related to environmental security, which should be seen as a part of energy security. Energy security is also related to the security of ecosystems. For example, I saw it when our government had almost decided to commission a block near the unique mangrove forest in the Sunderbans area for gas exploration, but could not go ahead because of public *opposition. The government had to back away. The exploration of fossils fuel sources is likely to impact the environmental integrity.*

Another aspect I want to comment on is, that if we talk of sustainable development then sustainable development basically relates to renewable resources. Concerns arise because of the rapid degradation of these resources. The main concern to my mind is that the industrial countries are unwilling to agree to the limits to growth. If we talk of sustainability, fossil fuels will get exhausted some day . What we need, as policy makers, is to invest part of the income from fossil fuels for re-generation of renewable resources in a proportion to their depletion.

Fossil fuels are gift of the nature. What we need is to add only the extraction costs. So ultimately, energy security will depend on how much we can reinvest out of the income of fossil fuels to the generation of renewable resources.

Question: *This is question for Mr Masuda. What are the IEA recommendations on the determinants? What should determine strategic petroleum reserves? What could be the factors the country should take into account on working on whether it should be 75 days, 60 days or 90 days?*
Answer: *Although we have stipulated 90 days of stocks, present stock levels hover around 110 days. However, a substantial portion of these 110 days of stock are not available for drawdown. As much as 40 days of stock are operational stocks held by industry. So probably, use of stocks for IEA members is roughly 60 days. So the question is: Would a stipulation of 60 days of stock be really comfortable for insurance? At that level, usable stocks would be about 35 days - 40 days, and that to my mind is very little. So we came to the conclusion to hold 90 days of stock.*

If India and other countries build stocks and if these are 100% government owned stocks, then probably 90 days is not necessary. Government stocks would not have an operational portion and would be 100 % usable. In fact, the IEA is recommending to many countries that stocks should be held by the governmental agencies rather than companies. My recommendation today to the Indian government especially is to get started to have as much as emergency government stocks as quickly as possible. Probably my recommendation is in light of the fact that India has 39 billion dollars of foreign reserves now. Why don't you use 10 % for the purposes of building stocks?

Chairperson

Closing remarks

Judging from Mr Masuda's presentation, I come to the tentative conclusion regarding the real concern of the energy security is one to distinguish the risk from high price from the risk of volatile prices. It is clear that what we are concerned about is the risk form highly volatile oil prices, rather than high oil prices. We quote form Mr Mehta that the long term marginal cost of oil will be around 15 dollars per barrel. Now current oil prices, are higher than those a year ago. However, 10 years ago the price of oil was 30 dollars/barrel and 20 years ago again the price of oil was close between 20 and 25 dollars/barrel.

In real terms, the current price between 27 and 29 dollars per barrel is not that high and probably if you look at some of the calculations of oil price in real terms it is so much close to 15 dollars per barrel.

So what we must guard against is the risk from highly volatile oil prices rather than the risk from high oil prices. When we consider the externalities of oil consumption, including military preparedness to have a secure oil supply chain, we may actually need much higher oil prices to protect our environment, to have sustainable development, to have renewable energy sources deployed in the future energy market. We should welcome high oil prices, but should not welcome volatile oil prices. With this tentative conclusion, I conclude this session. Thank you for your presentations and your interventions.

3 Developing strategies for energy security

Ambassador Farooq Sobhan

Chairperson

I personally see South Asian Energy Co-operation as the single most important issue in taking this region really out of the dark ages, which is where I think we are at the moment. Lot of it has to do with the inability of the countries of this region to really work together. But I think the dividends to be derived from co-operation in the energy sector are enormous and in the sense visible. It would be foolhardy, to say the least, for governments and the bureaucracy to continue as it were, to stand in the way. We have larger political issues, which come into play. We have the India Pakistan problem, we have the domestic problem in Bangladesh. This has had impact on the whole issue of gas exports. We have also, to my mind the somewhat inexplicable situation, where we spoke about the hydel power benefits to be derived from Nepal and Bhutan. There has been some progress in the case of Bhutan. I am glad to see my own old friend, the Ambassador of Bhutan, here with us this afternoon. But clearly much more needs to be done and I am hoping in an hour's discussion we will be able to touch on some of these issues on developing strategy for energy security. May I invite Mr Ron Somers who has recently taken over as President of Unocal Bharat.

Mr Ron Somers

President - Unocal Bharat

Thank you Chairman. The discussion I would like to share today is on integrating energy markets in the South Asian region. Because of the shortage of time we have four presentations in this session. I thank TERI, which has placed India on the map of renewable energy and sustainable energy conservation and brings a group of distinguished visitors like ourselves to this forum today which is extremely useful. As Mr Mehta said in his very articulate concluding remarks, it is going to be the bureaucracy, the NGO's, the think- tank of policy-makers which will bring the politicians to the difficult and courageous decision to move forward on integrating markets and developing options. I think these are the answers to energy security particularly in the south Asian region.

I agree with Mr Mehta's views. I don't see the energy security initiatives of terrorism as way back in the 70s and 80s with cartels putting on embargoes. Energy security for me is also developing every possible option. I see Ambassador Tshering from Bhutan and the concept of hydroelectric import to Bangladesh and I think it is an excellent concept that should be explored in earnest. There is talk as we know, about Iranian pipelines through Pakistan to India. We have mini terminals being proposed for Liquefied Natural Gas (LNG) imports on the west cost of India, and more aggressive development on Bombay High and further in the Cambay region of Gujarat and Maharashtra. But the real issue is of course, focussing on the eastern part of India particularly between countries like Bangladesh and India. The concept of a natural gas export pipeline from Bangladesh to India is exactly the kind of option that Mr Mehta was referring to. We need to put detailed development proposals on the table. We can discuss intelligently and move forward in making this courageous but very necessary decisions.

The programme that I would like to present today is a very interesting concept placed before the government of Bangladesh on November 7, 2000. We appreciate that the political issues float in the sense the proposal is coming up in the wake of elections in that country. The states that will be importing gas in India, are also scheduled for upcoming elections in India. There is a political element involved. But how do we get to the point of saying yes unless and until we place a concrete plan on the table. This plan we laid to one particular field, the Bibiyana Natural Gas Field, which is in the northeastern corner of Bangladesh, just a stone throw from Meghalaya and the states of Tripura and Assam.

But quickly see the agenda, why do we want to discuss this now? Obviously there is competition for a limited market. Our credit will be consumers of either gas or electricity. We have seen from the Dabhol power crisis on the Enron side on the West Coast of India. Everyone has assumed that there is a robust market. The fact is there may be a robust demand for electricity and a robust demand for gas, but there is a limited ability for the consumer to pay. So if Bangladesh doesn't bring gas to India quickly and capture the market, that market will be captured by the competitors, namely LNG.

I wanted to discuss briefly our contractual rights under the production sharing contracts that will allow us to bring this gas to India. Under the market criteria issue, some of the alternatives are explored and then the pipelines export plan itself. And of course the benefits of the pipeline not only to Bangladesh but also to India.

Why now? We believe that in the next 18 months the option for LNG on the west coast of India, particularly at Dahej, Hazira and also at Dabhol will begin to push gas into HBJ pipeline system already in place on the west coast of India. And the prized market of Delhi region and UP will be captured by those companies that are first to do so, leaving stranded in the ground the Bangladesh option for a number of years until a more robust market is able to grow in India. We have competition from LNG, we have competition from others, also from Iranian gas coming via a pipeline through Pakistan, and the captive fields of Bombay High, where there is lot more potential than earlier. Domestic gas will have the market advantage.

We must remember that the pipeline project that is being by proposed by Unocal Corporation is a 4-year construction effort. So if we don't go now, first gas will not come from Bangladesh till 2005.

We are talking about one extraordinary field of Bibiyana in the northeastern corner of Bangladesh. Extraordinary because, it is a world class accumulation of 6.6 trillion cubic feet of reserves, which means 287 million cubic meters of gas in place. Already 4.4 TCF of proven and probable reserves have been identified and that is an exceptional discovery. We also made an exceptional discovery at the Maluvi Baizaar field, also on the northeastern coast of Bangladesh.

These two fields by themselves are enough to provide 500 million cubic feet per day of gas into India over the next 20- 25 years.

Our production-sharing business contract is very clear about - Do we have the right to commercialise this field? Bangladesh is concerned whether we have enough gas supplies for ourselves. And only if they have enough gas for Bangladesh, the export alternative is there and they would wish to explore this opportunity. Accordingly, there is a resource valuation study underway in Bangladesh by the United States Geological Survey. And we are hopeful that they will confirm scientifically that the proven and probable reserves in Bangladesh are indeed significant, such that certainly 2.4 to 3.5 trillion cubic feet of gas could be considered for commercial export into the neighbouring country of India.

What the production-sharing contract basically says is first we would like to look at the option of LNG exports and then we come up with the other export alternatives. We have done that and considered that LNG infrastructure is a major investment development in its own right. About a billion dollars to build an LNG terminal, you have the LNG shipping-trains and you have the re-gasification on the country that receive that gas. The cost of that infrastructure makes LNG from Bangladesh infeasible and uneconomical. And hence we propose to the government of Bangladesh, very openly, that their natural gas pipeline is the most feasible way to bring first gas to India at most competitive cost.

We have looked at this in combination with the Petro Bangla and the Jalalabad Joint Committee and the demand growth for Bangladesh is along the blue line here between 2000 – 2005 (Annexure 3, Slide 7). Just in two fields that I have mentioned, the opportunity for exports supply is above that blue line, and as we begin to explore those fields we will begin to feed more gas. What I am suggesting is that there appears in these two fields themselves enough capacity growth to justify exports to neighbouring countries.

Market criteria of course are very important - Bangladesh market does not itself follow the criteria. They do not have enough demand for their own gas capacities. They have a lot more gas supply than they have the demand for. They also have the inability to pay for the gas volumes that may be produced. We want to recover some of the investments which Unocal itself spent. Our colleagues in Shell also invested significantly in Bangladesh. Up till now we have spent 340 million US dollars and to recover that obviously we need to be able to sell that gas. The market in Bangladesh cannot afford to absorb that gas and we have been looking for other markets.

We look at LNG. LNG is high capital gas and there is strong competition from the Middle East, low LNG landing prices from the Far East and India. Future LNG prices declining. The net back to Bangladesh is below the production cost we assume, therefore we recommend LNG for Bangladesh is not a viable export option. For net back calculations, we looked at potential markets for gas in Bangladesh - CNG, Petro Chemicals, Aluminum, Methanol, Gas to liquid, Fertilizers, Power exports, LNG, and natural gas export pipeline which we are advocating. And the result is that many of these options are value destroying, only a few are value adding - CNG and minimally, power exports. The pipeline is clearly the most advantageous economic alternative.

Where power is concerned, we looked very carefully and given the situation in India where you have the eastern region of the country with a supply overhang and given that there is no way to export from the eastern grid to other markets within India. The transmission cost from Bangladesh to India would make the alternative infeasible. Beyond that you have payment security issues which you have seen recently in the Enron project. Some states are not creditworthy. Therefore, financing large power project in Bangladesh to export into multiple state markets in India is simply not a viable option from the financial standpoint nor it is cost effective because of the transmission constraints of eastern grid.

I think we have to concentrate here because this slide (Annexure 3, Slide 11) shows where we are in north eastern Bangladesh. We know the gas is there. This is gas along Chittagong, gas in Sunderbans but here we have considerable reserves and this is one field from which they were proposing to export. You can appreciate that politically it becomes a concept to be able to sell to the general public, that there is one field and one field only for export to India. On that basis and considering that the resource is so significant, that itself can justify this extensive pipeline system. We are talking about a 1350-km pipeline, connecting with HBJ that already exists in India, that will traverse the entire country of Bangladesh, the Yamuna or Ganges or Paduda river into West Bengal. We will penetrate the newly formed state of Jharkhand, to Bihar into the vast state of UP which has an extensive market and is connected with the HBJ line in the Delhi area. We know this is a cluster of consumers that very badly need the gas. And the reality is that the Bangladesh Gas can come first to this market place at the most competitive price. If it can compete with that price LNG that is coming from this region of the country, then Bangladesh gas can begin moving and the money begins flowing. Bangladesh would be beginning to realise a revenue stream of 500 million dollars a year until the completion of the project.

The total cost of this pipeline system is 910 million US dollars. It would be traversing those four very important industrialised states serving India gas into the long future, and interconnected to the HBJ grids serving the customers, also along the HBJ line that have a deficit of gas. Why do we want to even connect Delhi near the HBJ pipeline? It is because we have found in our studies that the gas supply should fall along this route. To begin with, 1 billion cubic feet per day in the year 2005 expanding to 4 billion cubic feet per day by 2010.
Clearly India has a market and a need and the gas is in Bangladesh. To me it seems it is an extraordinary win-win situation. However, this window of opportunity we feel is closed by the way in which market in India being captured by competitors on the west coast with other LNG options. Therefore, Bangladesh needs to come to a decision quickly in order to capture that very important cut away market.

We have strong competition as I said, from other energy projects. The commercial structure of the project involves Unocal purchasing the gas from Petro Bangla at the well head. We formed a consortium in Bangladesh and formed a pipeline transmission company. Unocal carries the gas to India and Bangladesh border and then sells it into another consortium which consists of

GAIL and NTPC customers as well as Unocal. Unocal Bangladesh will sell to the Unocal Consortium in India and bring the gas to the end users.

We see the significance of benefits to Bangladesh and they are quite obvious. We're looking at revenues over the life of the project, job creation, construction procurement, obviously there will be use of local material and local contracts. We know that contractors in India are capable of laying the Indian section of the pipeline. New domestic infrastructure including optical fibre will traverse the entire route interconnecting hopefully one day, to the northeastern part of India. And I think there would be a tremendous vision to pursue.

On the Indian side, would be the reliable cost-effective supply of natural gas by the year 2005. There would be cost competitive gas at about dollar 3.50 and 4.50 per mmbtu in the year 2005. That competes very favourably with LNG and obviously the revenue and tax receipts to the governments of India and all the state governments over the life of the project, job opportunity, construction costs of 910 million dollars being divided by those four states through some local contracts. Obviously that would also include the linkage of fibre optic cable. Certainly when you have gas supply flowing in from the eastern part of India you have an interesting and very upside market for industrial as well as agricultural development.

I don't need to go into the summary. But very briefly we are submitting on June 30, a very detailed plan developmental plan to the Government of Bangladesh which includes financing, market criteria etc., and we hope to get a yes from them as soon as possible. With that yes decision in hand we will immediately commence the activities that are necessary to develop such a massive infrastructure project to ensure the long term energy stability in this region. I thank you very much.

Mr Hilal A Raza

Director General - Hydrocarbon Development Institute of Pakistan.

Thank you Mr Chairman. Mr Somers spoke on a specific project which is about to take off but I will be talking on something which hasn't been able to take off for the last several years. But before I do that I would like to extend my heartfelt condolences to the bereaved families of Gujarat and to share the grief and sorrow of the Indian people. As a matter of fact the shock that you had here was felt all over the country in Pakistan and by all people of Pakistan.

Energy requirements of both Pakistan and India have been rising during the last 10 to 15 years at the rate of 6 to 7% per annum. Currently, Pakistan's energy needs are about 44 million TOE per year and these are expected to double in the next 10 to 12 years. Pakistan is importing about 16 million tonnes of oil (TOE) per annum at cost of US$ 3 billion while the cost of Indian oil imports is around $ 12 billion annually. Similarly India's current energy needs of about 310 million TOE are also expected to double during next 10 years. At present, India is importing a quantity of 68 million tonnes of oil which will also double to 154 million tonnes during next ten years.

With the increase in the energy requirements and general awareness towards environmental issues, both the countries i.e. India and Pakistan have been looking for import of the cheaper and environment friendly natural gas from nearby countries having adequate gas reserves. There have been separate proposals of laying gas pipelines from Turkmenistan, Iran, Qatar and UAE to Pakistan and onwards to India. Any of these pipelines, if laid, could change the energy as well as the economic picture of the region and could be a means to dilute the political tension between the two neighbouring countries of South Asia. The project will bring the following major benefits to the region:

- Substitution of more expensive imported liquid fuels with consequent improvement in balance of payment.
- Relief to the hard-pressed infrastructure of ports, roads and railways used in movement of imported liquid petroleum.
- Shift towards gas-driven environment friendly energy economies.
- Reduction in the cost of electricity generation.
- Significant direct and indirect economic benefits during the construction and over the life of the project through employment, transit fees, availability of clean fuel, economic and industrial growth.
- Creation of new business and investment opportunities.
- Strengthen regional cooperation and provide a foundation for future economic growth throughout the region.
- Lower the regional tensions thus leading to quicker and sustainable resolution of other problems

It is not practically possible for India, or for Pakistan, to finance the capital costs of such massive projects through their own resources. Similarly, major technological inputs are also needed from outside the region.

Studies conducted to examine the techno-economic options of importing natural gas by India and Pakistan individually or jointly, show that for optimal techno-economic benefits, India and Pakistan should move jointly on the project. The economies of scale will substantially reduce the cost of a unit of gas energy imported jointly than individually. According to an economic analysis conducted by HDIP for a UNDP sponsored project on Energy-Environment Co-operation in South Asia, based on the then prevailing prices in March 1998, the tariff cost could be reduced by about 26% by having a joint pipeline for India and Pakistan as compared to having separate pipelines.

Pakistan has been very positive in co-operating with India on this issue. It has always been supporting the construction of gas pipelines to India through its territory whether it be from Turkmenistan, Iran or Qatar. Recently, the Government of Pakistan has declared its official approval and guarantee for the proposed gas pipeline from Iran to India through Pakistan territory. Pakistan is willing to meet the legitimate concerns of India but these need to be brought out clearly in order to be resolved. We have agreed with Tata Energy Research Institute's proposal to undertake a joint collaborative project for developing the outline, basis and documentation necessary for a treaty for a trans-boundary gas transportation project so that as and when such a project gets a go-ahead from all sides, we are better equipped for the execution phase.

Summarising our efforts, views and thinking to promote the share of natural gas in the South Asian energy mix for environmental and economic reasons and for addressing concerns of energy security, we can draw the following conclusions consistent with the UNDP project findings:

i. Optimal techno-economic solution is for India and Pakistan to jointly pose their demands to potential suppliers in the north and the west so that economies of scale result in a substantial reduction in the unit cost of supply to both countries.
ii. A land route via the territory of Pakistan is the preferred option for economic, technical and security of supply considerations.
iii. Inter-governmental arrangements between India and Pakistan need to be made to signify a joint and mutual declaration of intent and inuring the project from perceived non-commercial risks, especially those of political and security nature.
iv. Four major directions through which an appropriate climate of opinion can progressively be created are:

- Full fledged preparatory techno-economic work.
- Intergovernmental agreement.
- Informed public opinion.
- Promotion of international commercial and financial interest in the proposed projects.

The governments of India and Pakistan are urged to positively pursue these proposals and address themselves to a number of issues including commercial terms, identification of routes, security of supplies, non-commercial risks such as natural disasters, political tensions, internal disturbances, terrorism, armed hostilities and international sanctions, joint supervision mechanism, modalities for settlement of disputes, and a time-frame.

Non-governmental or quasi-governmental organisations can play an effective role in carrying out preparatory work necessary for undertaking such a large multi-national venture which has no precedence in the region.

Mr. Sugeeswara Senadhira

RCSS- Sri Lanka

Though I had a prepared lot of points, most of them have been covered in an articulate and extremely eloquent manner by Dr Pachauri in his paper itself. First of all let me thank Dr Pachauri and Mr Ardhendu Sen for inviting me to this session. And I compliment the TERI team for its excellent arrangements. I will skip most of my prepared points and briefly tell you about the Sri Lankan situation. There is a strong link between energy and South Asia and it is not surprising to find that 1.2 billion people who live in the region attach a high priority to energy services. An average south Asian spent 12% of his disposable annual income on energy, more than five times the average of people living in the developed country. Well, I will cut down on these as most of you all aware of these facts.

In the south Asian region it is evident that from 1971-1997 Sri Lanka had the best performing energy efficiency path. Sri Lanka had progressed to achieve this highest per capita income and lowest energy intensity level. This is remarkable. National development efforts have been strained by the ongoing separatist wars where almost 60,000 people have died over the last 20 years. Thus 20 % of our budget goes for defence. Sri Lanka's economic growth and energy efficiency can be attributed to the pragmatic yet bold approaches to the policies that they are not developed. For instance in 1977, Sri Lanka was the first country to make the transition from an inward looking social system to a market-based economic system based on liberalised trade, exchange arrangements and a deregulated foreign investment regime.

On the energy sector, Sri Lanka's energy planners in the late 1970s utilised resources and built a hydroelectric dam. In fact, Maha valley scheme was originally planned for 30 years. But after opening in 1978 we decided to accelerate the process and finish it in 7 years. As such we 90% of our energy production from hydro, but because of the vagaries of nature, every once in four years or so we have drought affecting our electricity production. Hence we have to depend more on oil imports.

About possibilities of purchasing from Bhutan and Nepal. This was discussed way back in 1987 in fact there was almost an agreement between India and Sri Lanka, rather the Tamil Nadu state government and Sri Lanka in 1987 to buy power from Sri Lanka, because during the monsoon Sri Lanka had surplus electricity. They also have plans to sell the power to Tamil Nadu but that was immediately after signing the Indo-Sri Lanka agreement of 1987 to solve the ethnic problem in northeastern Sri Lanka. The plan didn't work out despite deployment of Indian troops, when fighting broke out with the IPKF and LTTE. So the economic plan took a back seat there. I will skip now the remaining parts as most of you are anticipating the question-answer session and also would like to express your comments. Thank you.

Commodore Talwar

DDGDPS/ COSC, Ministry of Defence

Thank you Ambassador Sobhan. The maritime aspects of energy or oil security are important, and I will try to cover this aspect.

In the foreseeable future, much of the volume of fossil fuels will continue to move on the ocean highways, notwithstanding the gas pipelines. This has implications for the energy security and national security of nations in the region and calls for co-operation among them.

At present, the US is in this area and will continue to be there in our estimation, till they need oil from the Gulf. But the requirement is likely to reduce over the next 10-15 years which implies that US involvement could decrease and this calls for co-operation among the South Asian nations in the region.

The study of seven major disruptions of world oil supply cited by Dr Pachauri earlier clearly reveals that all of them had not only political but military implications as well. Three of the choke points through which oil tanker traffic travels are very close to India, one is the Gulf, which is only about 600 miles from our coast, while the other two are the Lakshadweep islands (near the nine-degree channel) and the Andaman Islands (near the six-degree channel). India must cooperate with other countries in the region to increase security.

Every day over 360 ships traverse the Indian Ocean, on an average 50 super tankers daily pass the nine degree channel in the Lakshadweep and six degree channel in the Andaman islands. Annually over 200 billion dollars worth of oil comes out of the straits of Hormuz, of which 70 billion dollars worth passes through the straits of Malacca. India is in the direct path of these commercial routes, which can be termed as energy lifelines, and thus we are in a strong position to influence the secure movement of shipping, prevent terrorist and piracy activities. Just to give an example, take the case of piracy in the Malacca straits, whereby huge tankers are left without command. If these tankers deviate from the normal path which is already very narrow in the Malacca straits, they will land up running a ground. This could create a huge environmental security disaster and therefore cooperative measures are extremely important.

By 2020 the requirements of oil in South Asia, and in India are likely to grow to approximately three times of what they are at present. The number of VLCCs (Very Large Crude Carriers) operating in the Indian Ocean region, passing through choke points each day which now stands at 50 will be in the region of 150-200. This will require extreme measures in the form of vessel traffic management systems to ensure lane separation and traffic separation zones. Much of the traffic also passes south of Sri Lanka near Dondra Head and there are already traffic separation zones there, but these will have to be well guided and controlled. These have to be factored into our maritime force structuring which will be required to look into these aspects.

For India the situation is even more precarious. With our present oil consumption of 57 million tonnes (expected to go up to 150 million tonnes by 2020) we require one VLCC every day for 365 days of the year, to run our supply lines or to run the engines of our industry. This will increase to 3 or 4 tankers. Not only will we have to control this traffic, but there will be requirements for larger facilities at ports, harbours, off shore terminals etc.

I now come to the subject of offshore security. The offshore oil and gas infrastructure in India is spread over a very vast area, both on the western and eastern coasts. The area covered extends over 40,000 sq. km and extends beyond 200 km of the coastal line in the exclusive economic zone. We are now further extending into deeper waters; offshore installations are easily approachable and vulnerable to collisions, accidents, sabotage, disruption by terrorists, and also attacks from the air and or from ships as also from submarines. Eternal vigilance is needed and cooperation is required for this. Given the mutual suspicion between nations, the process of cooperation will be slow. We have to ensure open access to sea links in the Indian Ocean, safety of choke points and exchange of intelligence information. If necessary we can even have a regional energy agency like the International Energy Agency. Inter-operability between our maritime units, policing and damage control resources, joint patrolling, joint anti-piracy and anti-terrorist measures, and of course the installation of VTMS (Vessel Traffic Management Systems) at choke points, joint disaster management plans and pooling of resources should be pursued. The recent earthquake is an example of the potential environmental impacts. In the Gulf of Kutch about 7000 ships are expected to traverse in the year 2020. Serious damage could take place if even if one of these tankers breaks apart in a serious earthquake or seaquake in the region. There is no choice but to cooperate and ensure that we pool our resources and have them available to us as and when required. Thank you very much.

Question - answer session

Comment: *Thank you chairman. I think what we really lack in South Asia is clarity in government policies. If we are really looking towards a regional market for power, or gas, or for oil, we should work for harmonization of some of these policies.*

My second submission is that when you really talk about a source like Bibiyana in Bangladesh and when you target markets in Tripura, Assam or Meghalaya, the first thing we have to do is to sensitize state governments. The state government is not aware of any of these initiatives at all. What is really lacking at the moment is state governments' involvement though many of them have got their own investment policies.

My third submission is that we need just one project in South Asia which has both cross-regional and cross-country implications, and which is run on a purely commercial basis. The SAARC process has really failed to take off in the last 15 years, not a single project with regional implications has been implemented.

Finally, as far as South Asia is concerned trade and investment should be integrated in the region. One of the major complaints of most of the smaller countries in the region is that there are huge balances of trade deficit with India. One fundamental aspect is that most of these smaller countries have very limited items in their export baskets. Energy is one of the major products which can diversify the export basket. The case of Bhutan can be cited in this context. Over the last seven or eight years it's exports to India increased almost 8 to 10 fold. One major product is power and it constituted almost 35% of it's export basket. So what we really require in South Asia is some kind of regional framework as far as power trading is concerned. There are some studies which look at demand and supplies and what the basis should be for power trading in

South Asia. These studies could be brought together to sensitize policymakers across the region, and then initiate some projects in this area. Thank you.

Question: *This question is directed to Mr Somers regarding the analysis of the Bibiyan gas project. Why do you expect that future prices will be lower, that is LNG?*

Answer: *I believe Mr Mehta from Shell will agree with me, when you have the quantum of development taking place in the Middle East in the gas fields and LNG terminals that are now proliferating on the West Coast of India, you are going to see the landed price of LNG coming down over time. We have also talked about basket prices of crude oil that is driving prices down as well. So, the first gas to the market place is going to win the prize so long as it remains cost-competitive. The argument I am trying to raise is that Bangladesh gas has an export potential. But they have to appreciate that timing is critical, because if you are first to go to the market and present a cost-competitive price, you will score over competition from the west coast or other alternative energy suppliers from the western side.*

If I just respond to Prof. Lama's point, you made a good reference to Bhutan's export of hydroelectric energy and I think there is tremendous opportunity for exporting electricity from Bhutan into Bangladesh to serve their electricity. That's a great example of energy regional cooperation. Nepal-India energy cooperation is another example. To my mind energy security means diversifying portfolios and thereby making energy options. As Mr Mehta articulated in his conclusions, it makes so much sense now that we need to remove political barriers using organizations such as TERI. At the end of the day we are a global community sharing the same energy security concerns.

Let me just very briefly add a word to sum up. I think it would make an enormous difference in gaining domestic acceptability for the whole idea of gas exports to India if we had on the table the possibility of Bangladesh purchasing the electricity from Bhutan and also eventually from Nepal. This would be an enormous plus point in the whole process. Therefore, there is all the more reason that we really step up our efforts to address these issues and problems on a regional and possibly sub-regional basis. Thank you.

Comment: *Our friend Mr Lama has covered my idea about regional problems and this should come as a package or framework including a linkage politics approach, because there is syndrome of small or bigness in all those things. I focus on two-three points.*

For example, in South Asia, while we have to talk on energy security we have to look at system loss. In South Asian countries system losses run up to 25 to 35%. But the actual technical losses are just 7 to 10%. We should have some kind of co-operation in improving this aspect also.

And then there are issues in terms of pricing also. There has been a report that the domestic price of petrol in India is high. So pricing energy products also should be rationalised otherwise energy security will be challenged.

Chairperson

Closing Remarks

We had very rich presentations from our two lead speakers as well as from our panellists. I would like to end our proceedings this afternoon on a note of optimism. I am convinced more than ever before that we really must not simply put the whole issue of regional co-operation in South Asia on the table but really try and back it up with action. The one area where I think we can move forward and quickly in our own self-interest is the energy sector.

I am convinced that gas exports will happen and they will happen very soon. But at the same time what has our recent experience taught us? Whether we look at ENRON or even recent experiences in Bangladesh in negotiating with oil and gas companies, as well the power sector, there is an acute shortage of expertise and experience within governments in addressing these problems. Hence, there is a tendency to be extremely cautious and that cautiousness becomes an excuse for inaction. I think we need to overcome these barriers, some of these are psychological and political but are real barriers.

I think it is equally important that we address certain key issues. One issue raised this morning was on the whole issue of deregulation and development of expertise independent of the government. You really cannot have a level playing field without having an objective and independent referee in arbitrating the procedure. And that is why the mechanisms we need to devise are also important in promoting regional co-operation. I am confident these things are now finally moving forward and that there will be a success story in the energy sector.

I would like to thank TERI for taking this initiative and I look forward to working closely with TERI in the months to come. We in Bangladesh are launching a project on South Asian Energy Co-operation which will be inaugurated in the middle of March. We hope some of you who are present here this afternoon will be able to join us at this meeting. Thank you.

4 Valedictory session

Mr N N Vohra

Chairperson

Director - India International Centre

Ladies and gentlemen this is now the concluding valedictory session and we have two distinguished speakers. One is Dr. Pachauri, Director of TERI, who has masterminded this discussion over the last several years. He has been trying to focus more and more pointed attention to issues relating to energy, energy security and co-operation in the field of energy, and this time focussing on what countries in South Asia could or should be doing to proceed in this direction. I will now call upon Dr Pachauri to please present his views.

Dr. R K Pachauri

Director - TERI

Thank you chairman. We discussed a large number of subjects and I think we covered the ground effectively so I would only like to highlight a few issues which perhaps need reiteration. Since we are taking view of South Asia as a whole, my submission is that we should not question what the cost, or what the economics of a specific option would be, rather we should ask what would be the cost, or the economics of inaction. And I think the time has come for us to carry out a comprehensive exercise for South Asia to see what inaction is costing us. People of the region really don't have effective co-operation in several of the sub sectors of energy. I would like to put this forward as a suggestion, and am willing to join hands with institutions in the region to explore details of projects of this nature, where we look at the economics of action versus the economics of inaction. Ultimately it is the consumer who is going to benefit and the people of the region in our respective countries who are paying for high cost energy and the insecurity of supply. If we were to create a more secure arrangement or infrastructure in the energy sector, there would be an economic benefit which would percolate to all people in this region. I would like to submit this as a suggestion and if there is any response I will be very happy to take the initiative and cooperate with our friends and partners and may be others outside of this region to enter into a major project, which we would like to bring to the attention of the policy makers.

The other point I would like to make relates to what Mr Suresh Prabhu said this morning and in a sense is an extension of what I said earlier. Perhaps the most important issue of energy security is cooperation. I think we have to create a climate whereby at least members of civil society and those in academia, research institutions and others are able to come together to raise this debate to a level where people see economic and energy cooperation as distinct from the political problems that may be existing in this region. As a matter of fact I have always believed that if we can identify objectives and actions in some of these economic spheres, it will make a vast difference to even the political atmosphere. Because the moment a mutuality of interests is established in economic terms, it will undoubtedly bring about a new environment. This may sound like a utopian dream but I want to emphasize that one is not looking for any magical changes that might come about tomorrow, but certainly this is the direction in which we should move. Therefore, I am particularly delighted to have participants and distinguished friends from the region participating in this workshop here today.

I will just make two other observations. The first one relates to the enormous benefits of using natural gas in South Asia. We must find every possible means to enhance the supply of natural gas, because this will benefit not only specific countries that may be able to supply gas but also those organizations that may be involved in creating and operating infrastructure for supply of gas. It is a matter of fact that this may be one of the options by which we can take energy to our rural masses, because tomorrow undoubtedly and not in the very far and distant future you will have technology such as fuel cells, which will make it possible to generate power on a decentralized basis without any loss or any diseconomies of scale. It should also become possible to move some of our enterprises that are currently located near urban locations to rural areas. One major constraint in the dispersal of industry is the lack of energy that is essential to bring about any kind of industrial activity in rural areas. So I see this as a structural possibility that can change the very nature of economic development in the region.

The last point is, with regard to renewable sources of energy. I think this subcontinent is blessed with enormous potential for renewable energy sources. But we are not really pursuing renewable energy development in the manner that it should be. It's far too much of a subsidy-driven, government-operated programme. We are not utilizing the market in the manner that we should. We are not involving the community in taking some of these decisions. So major changes are needed in the manner in which this programme is implemented. Consider the importance of economies of scale in renewable energy development. Take the case of photovoltaic cells. If you set up a factory that manufactures 250 MW of capacity each year the cost per unit is substantially lower than a factory we have today in Bangalore manufacturing 45 MW of photovoltaic devices during the year.

I think if we see the integration of markets in South Asia, then these economies of scale will benefit every country in the region. It is entirely possible that you have photovoltaics, maybe located in India, and some other set of devices, maybe fuel cells in Pakistan and other devices in Bangladesh. There will be free trade and better understanding and cooperation. Mr Hilal A Raza made the point about coordination in pricing. You don't have impervious borders but if petrol sells at higher price in India then obviously you provide very strong signals to others in our neighboring countries to indulge in trade. I think it is important to start looking at possibilities by which we can coordinate at least the broad parameters of our policy. And at the centre of it should be a realization of economies of scale since we can't do it by changing the power structure overnight or changing other distribution structures of other forms of energy. Let's at least start doing it in the renewable energy sector. I think everybody will benefit and it will be a win-win situation. Thank you, Chairman.

Mr N N Vohra
Chairperson

Thank you Dr Pachauri. I am sure all the things you said will perhaps be possible in the years to come, if some of the political and what the psychological barriers that Ambassador Sobhan referred to. I am sure that with the collective wisdom of distinguished representatives from various countries here today and if we continue this dialogue and do all that is necessary to get rid of these psychological doubts and worries, we will start moving in the direction of enjoying the benefits. Dr Pachauri said we suffer from enormous losses due to inaction, of not moving in the direction in which the discussions have pointed to. Now I have great pleasure in requesting Ambassador Lyompo Dago Tshering, Ambassador of the Royal Bhutanese Embassy to make his presentation.

H.E. Lyompo Dago Tshering
Ambassador, Royal Bhutanese Embassy

Thank you Mr Vohra and Dr Pachauri for inviting me to participate in this workshop. I must express at the outset from all our minds and hearts our sympathies with the people of Gujarat who are struggling for their lives and who have lost near and dear ones. Bhutan being a small country and small in resources, we have not been able to send or dispatch any aid or teams but we have been able to make a token contribution of 2 crores to the Prime Minister's Relief Fund. However the situation in Gujarat in many ways uplifts your spirit, as there was tremendous cooperation and we hope this is the beginning in our region and particularly in our sub region in south Asia.

We are all dependent on energy for the well-being of our people and we do pursue in our own ways sustainable development, and energy is the key to sustainable development. Somebody said economic growth fuels demand for energy. I would say the availability of energy would also stimulate the growth of economic activity.

At the Delhi Sustainable Development Summit, somebody said that US and Japan together consume 50% of world's energy. And somebody questioned how long they can sustain it. This reminded me that we in our own region and in our own countries look at how energy consumption in our mega cities can sustained from limited sources of energy if we are also to look after the well-being of people in the rural areas and provide energy to them.

In South Asia the per capital consumption of energy is very low but it is rising. The region has one fifth of the world's population, so it is natural that the consumption of energy will be rising rapidly. But what are the sources of our energy? These have been explained this morning by Dr Pachauri and many others. Coal has been placed on the top of the list, hydroelectricity, natural gas and oil, nuclear energy and other renewable sources of energy which Dr Pachauri just touched upon. When we look at all these sources of energy, oil continues to be the vital source on which, in one way or the other, we are all dependent. It looks like whether at the global level or in this region or sub region, all the countries individually will have to do something. For energy security in each of our countries and our sub region, we should diversify our sources of energy or find alternative sources.

As far as hydropower is concerned, it looks comfortable because this region is well endowed with enormous resources of water. But these resources have to be harnessed. We heard this morning from the Minister of Power, India has the potential to produce 150 000 MW of power. Nepal has about 83,000 MW of power potential and Bhutan about 30,000 MW of power potential. As far as the exploitation of hydropower in Bhutan is concerned, we have been exporting only 300 MW to India. But within three years of time we shall be producing 2000

MW of power. So I am happy to say that in about three years time we will be contributing to the requirement of the sub continent, particularly to India.

Another 2000 MW of power can be potentially exported, but the question is how do we move ahead? As Mr Mehta this morning reminded us, resources are not abundantly available. Can we raise the needed resources? Do we have the required technology? Can we afford to pay for these? I think these are some questions that cross my mind at this stage. And I am sure as we move along and progress many more questions will arise which will have to be tackled in the course of time. In the meantime, plainly we have to think in terms of a co-operative mode in the region ensuring greater security of energy and the interests of our people and their well being.

The way to move towards achieving some of these is through sharing of information. As I mentioned earlier, we can conduct research together for developing technology and improve the quality of our services together. We can optimise utilisation of energy, transmission and distribution which I believe at present are some of the problems that afflict our sub region and many of the SAARC countries.

Apart from that I think we also should see whether in some way or other we can integrate the market system in the sub region. Whether in terms of funding, integrating the marketing system or establishing some form of grid which I think Mr Somers mentioned - a gas grid or power grid in the sub region so that our resources can be pooled and put to optimum use. This is not going to be easy. But in the meantime, the best thing seems to be what TERI is organizing, to bring us together to exchange views and try to learn from each other's problems and concerns and see how we can overcome these problems, whether of economy, resources, or political. So ladies and gentlemen, Mr Vohra, Dr Pachauri you can see that countries in South Asia need to do more. I hope in the 21st century we can do it better. Thank you.

Chairperson

Closing Remarks

Thank you very much for your sharing of views and the very positive note that you sounded in terms of our future possibilities. I remember it was three decades ago that I had the opportunity to visit your good country. And that happened to be in connection with collaboration in the area of power production. Indeed it is a very heartening thing to note that Bhutan will very shortly be able to export over 2000 MW of power. My own perception is that the potential in Bhutan, which Ambassador Lyonpo Dago Tshering just mentioned, is even larger and so also in Nepal.

For some reason or the other it appears that in both the case of Bangladesh and Nepal, we haven't been able to make the kind of headway that we should have been able to do in the years past. But hopefully with the discussions TERI has organised in recent months we will be able to at least partially succeed in liquidating some of the doubts and reservations that we seem to have on this question of energy security and energy co-operation. Let me say Dr. Pachauri that while you are a known expert in this area, I am not a known expert in any area, but for the last two years I have been involved in speaking and looking at various aspects of military security. All I can say in brief is that if one takes an honest view in our own region of South Asia, military security will become virtually a myth, if we have no energy security.

So I am pushing this point further and talking all the time about military security especially in the context of the levels of socio-economic development that we all face in our respective countries. I think the straight forward and simple answer is total co-operation in every field but co-operation in the field of energy production, transmission, sharing, appears to me to be the most fundamental and pressing area where we should start collaborating. There will be very little economic growth and development and consequently very little human growth and development if we continue to subsist in the kind of situation in which we are; nothing will develop for want of energy resources.

There is vast potential even in the area of alternative sources of energy. Here again as Dr Pachauri made a brief reference, the potential for co-operation is unlimited. I do not know at what point of time in the coming months and years we will be able to really get going but all I can say is that it should be our common endeavour to move in this direction.

The pressing concerns for social and economic development in all our countries are our selfish concerns and we can put all these under a common umbrella for collective concern. We cannot continue in the kind of the situation we are placed. The last report on the state of human development in South Asia and the one before that makes very depressive reaching as to where we stand. And why is it that we stand where we do? So I would, Dr Pachauri with your permission, conclude this session and carry forward hopes that Ambassador Sobhan expressed that we seem to be on the verge of doing bigger and greater things together. Thank you very much.

Annexure A

Presentation by Dr R K Pachauri
Director, TERI

Energy Security Concerns
&
Response Strategies for South Asia

R K Pachauri

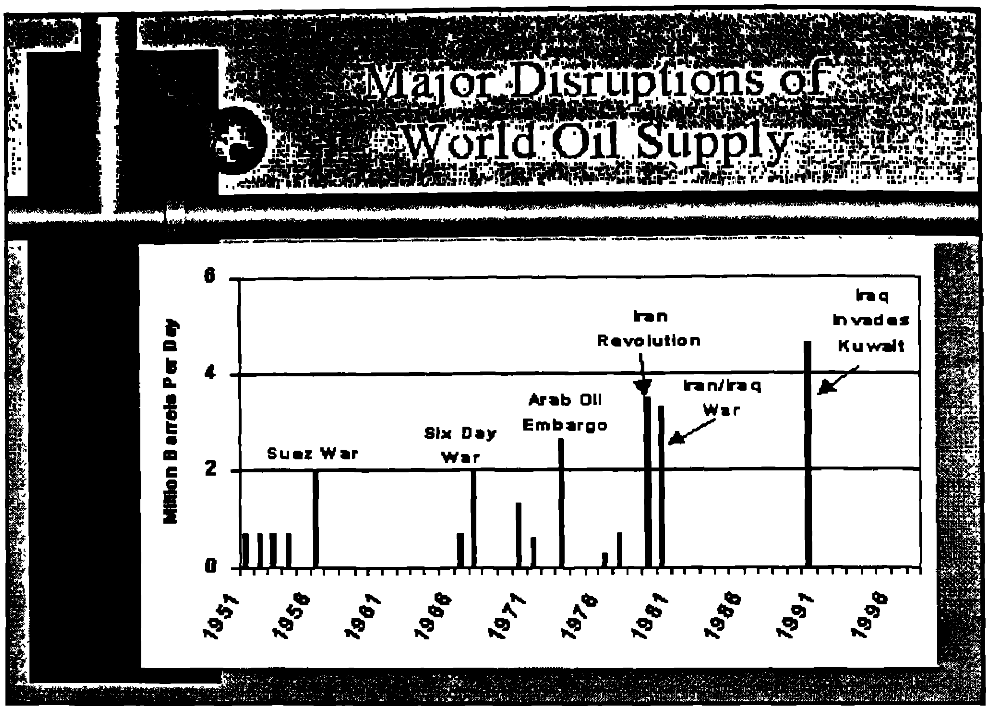
Director TERI

10th February 2001

Introduction

- I **Introduction**
- II Energy Scenario in South Asia
- III Energy Security Issues
- IV Response Strategies
- V Key Issues

Major Disruptions of World Oil Supply



Energy Security: Defined

Reducing vulnerability to supply disruptions

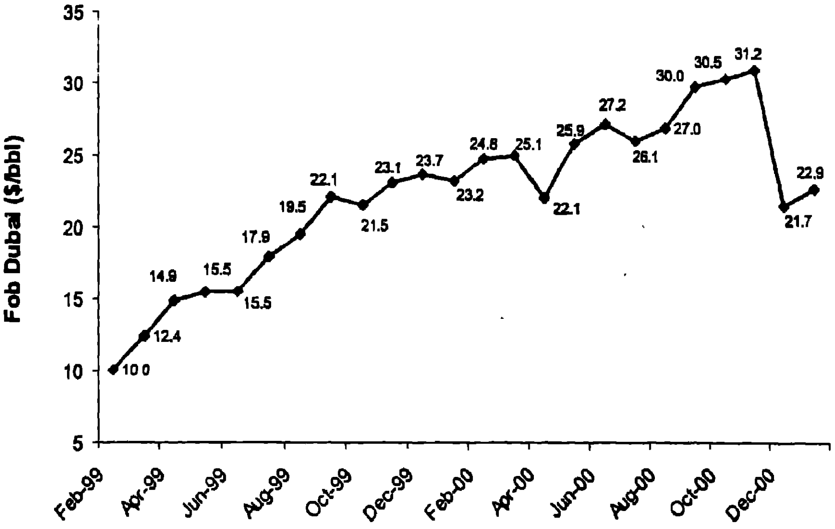
+

Smooth functioning of energy markets

+

Minimise environmental damages & promote sustainable development

Oil prices: 1999-2001



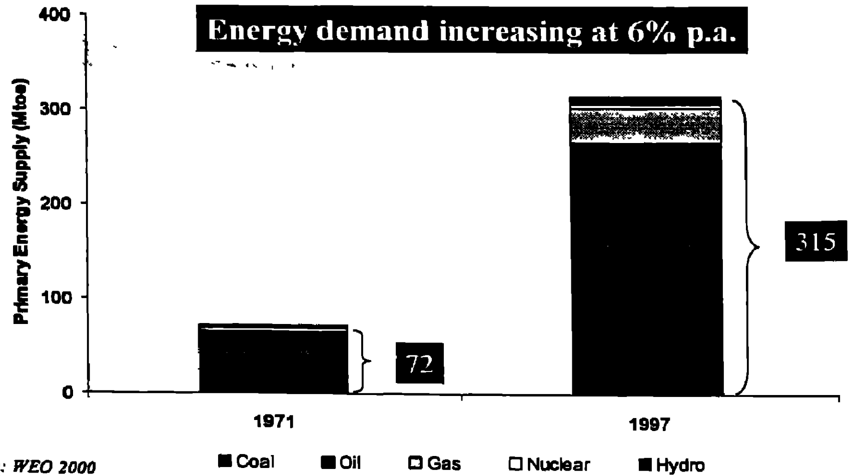
...Oil import bill: 2000/01

Country	Increase in import bill
India (estimated)	Rs 265 billion
Pakistan (First Quarter)	Rs 33 billion

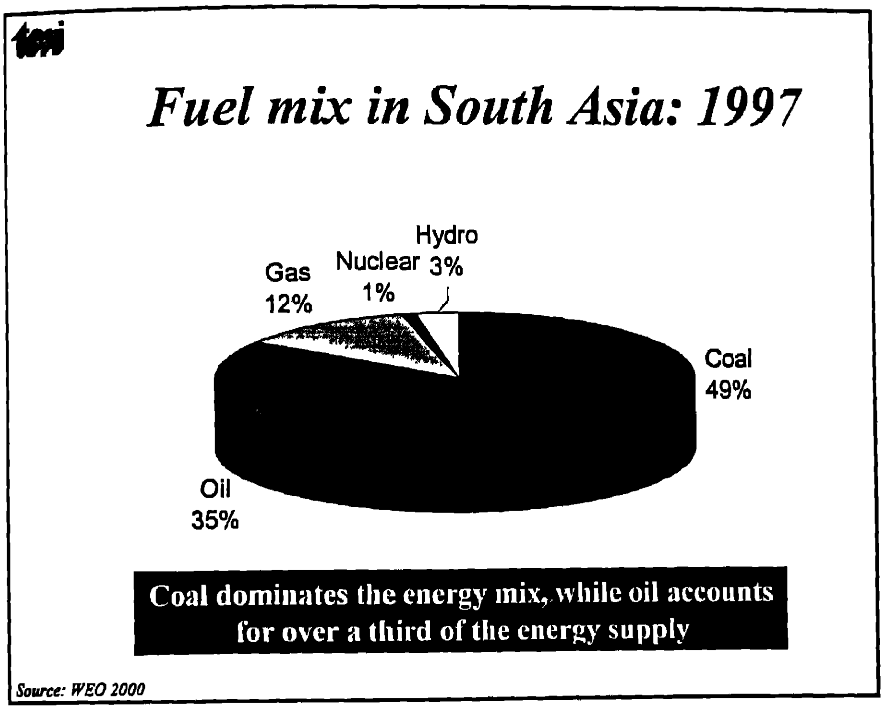
Energy Scenario in South Asia

- I Introduction
- **II Energy Scenario in South Asia**
- III Energy Security Issues
- IV Response Strategies
- V Key Issues

Energy Supply in South Asia



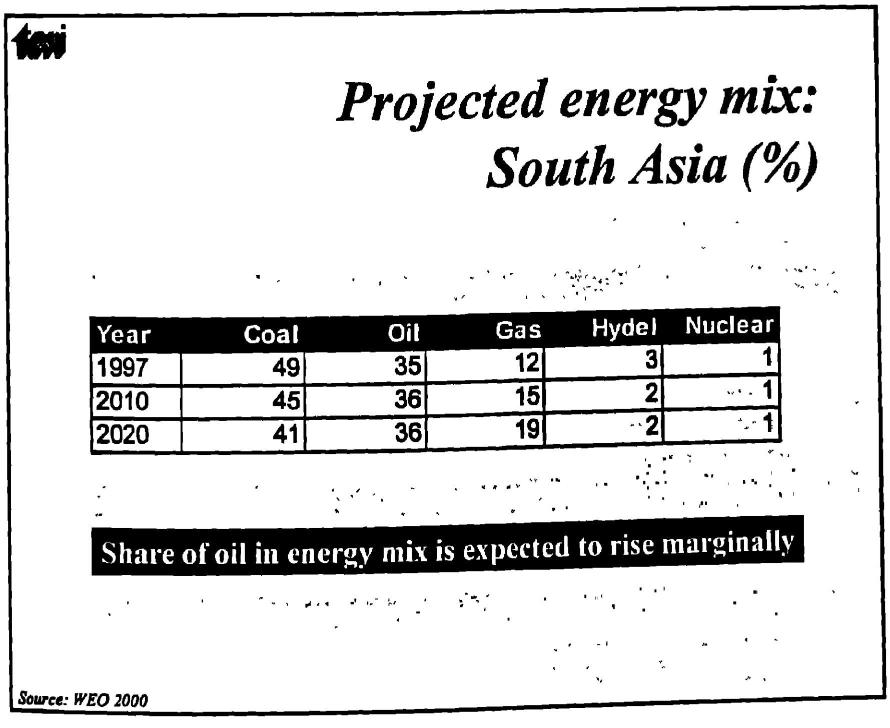
Source: WEO 2000



Fuel mix in South Asia: 1997

Coal dominates the energy mix, while oil accounts for over a third of the energy supply

Source: WEO 2000



Projected energy mix: South Asia (%)

Year	Coal	Oil	Gas	Hydel	Nuclear
1997	49	35	12	3	1
2010	45	36	15	2	1
2020	41	36	19	2	1

Share of oil in energy mix is expected to rise marginally

Source: WEO 2000

Resource requirements: South Asia

Fuel	Units	1997	2010	2020
Coal	MMT	233	378	516
Oil	MMT	111	203	304
Gas	BCM	33	78	147

South Asia's oil demand triples over the next two decades

Source: WEO 2000

Resource endowments & production

Fuel	Units	Bhutan	Nepal	Sri Lanka	Bangladesh	Pakistan	India	Total
Reserves								
Coal	MMT	1.3	2.0			3228	79106	**82337**
Oil	MMT				8	28	715	**751**
Gas	BCM				300	612	675	**1587**
Production								
Coal	MMT	0.001	0.01			4	359	**363**
Oil	MMT				0.08	3	33	**36**
Gas	BCM				9	20	27	**56**

While coal R/P ratio exceeds 200 years, R/P ratio for oil at 21 years is low

Source: EIA Country Briefs, TEDDY

Energy Security Issues

- I Introduction
- II Energy Scenario in South Asia
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- IV Response Strategies
- V Key Issues

Oil resources

- India accounts for 90% of the oil production in South Asia
  - Of the 26 sedimentary basins, only 6 are moderately explored
  - Private participation being encouraged under the NELP
    - 27 blocks awarded under Phase I of NELP
    - 10% production from private/JV fields
- Bangladesh - aggressive programme for exploration attracting MNCs

Despite steps to increase domestic oil production, oil imports into South Asia are likely to magnify

International oil market

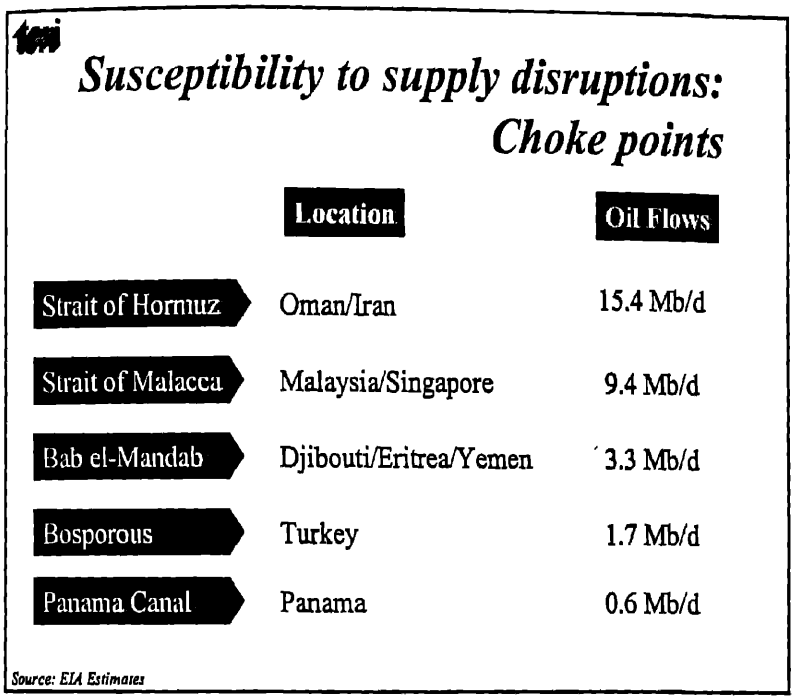
- Periodic disruptions in supply
- Price set by a cartel
- Global R/P ratio of 41 years

Reliance on Persian Gulf

Region	1998	2005	2010	2015	2020
Persian Gulf	24.0	28.0	31.4	36.9	44.8
Other OPEC	10.2	12.6	13.7	13.9	14.0
OPEC	**34.2**	**40.6**	**45.1**	**50.8**	**58.8**
Non-OPEC	44.5	47.1	51.5	54.8	56.6
Total	**78.7**	**87.7**	**96.6**	**105.6**	**115.4**

Share of Gulf in world oil production to rise from current 30% to 40% by 2020

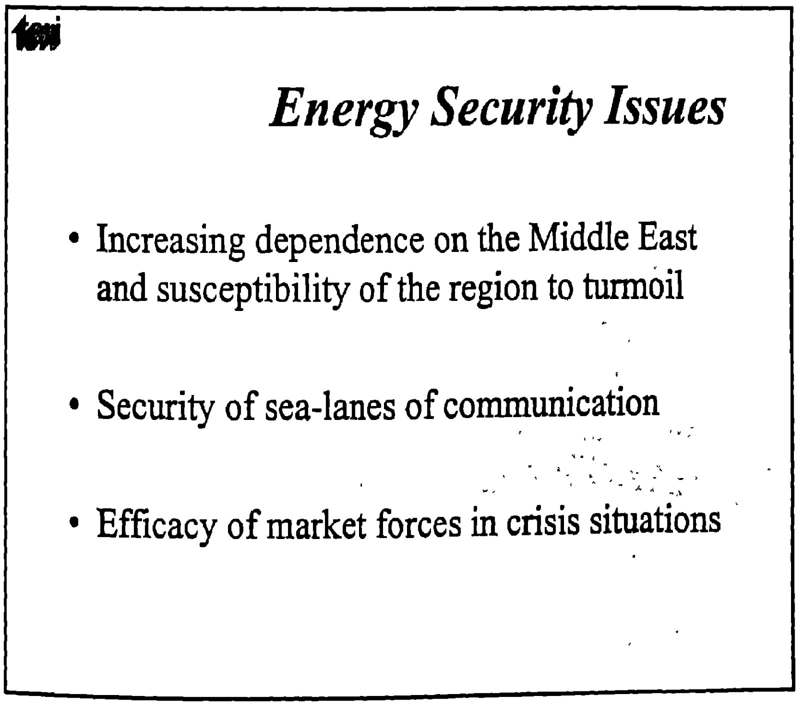
Source: IEO 2000



Susceptibility to supply disruptions: Choke points

	Location	**Oil Flows**
Strait of Hormuz	Oman/Iran	15.4 Mb/d
Strait of Malacca	Malaysia/Singapore	9.4 Mb/d
Bab el-Mandab	Djibouti/Eritrea/Yemen	3.3 Mb/d
Bosporous	Turkey	1.7 Mb/d
Panama Canal	Panama	0.6 Mb/d

Source: EIA Estimates



Energy Security Issues

- Increasing dependence on the Middle East and susceptibility of the region to turmoil
- Security of sea-lanes of communication
- Efficacy of market forces in crisis situations

Response Strategies

I Introduction

II Energy Scenario in South Asia

III Energy Security Issues

IV Response Strategies

V Key Issues

Substitution of oil

- Transport sector accounts for 53% of the total oil consumption in South Asia
- Any successful substitution policy **must** address the transport sector

Substitution by power

- Railways
  - Track electrification already in progress
  - Share of oil consumption in railways minimal
- Roadways
  - BOV (battery operated vehicles): Technology at experimental stage
- Power sources to be examined ...
  - Coal/hydel/nuclear/renewables

Coal

- India accounts for 96% of South Asia's coal reserves
- Poor quality of Indian coal: High ash content & low-calorific value
- Abundant coal ... a myth

Year	Demand	Supply	Deficit
2001/02	371	360	-11
2006/07	545	499	-46
2011/12	775	672	-103

Source: Ninth Plan Mid Term Review

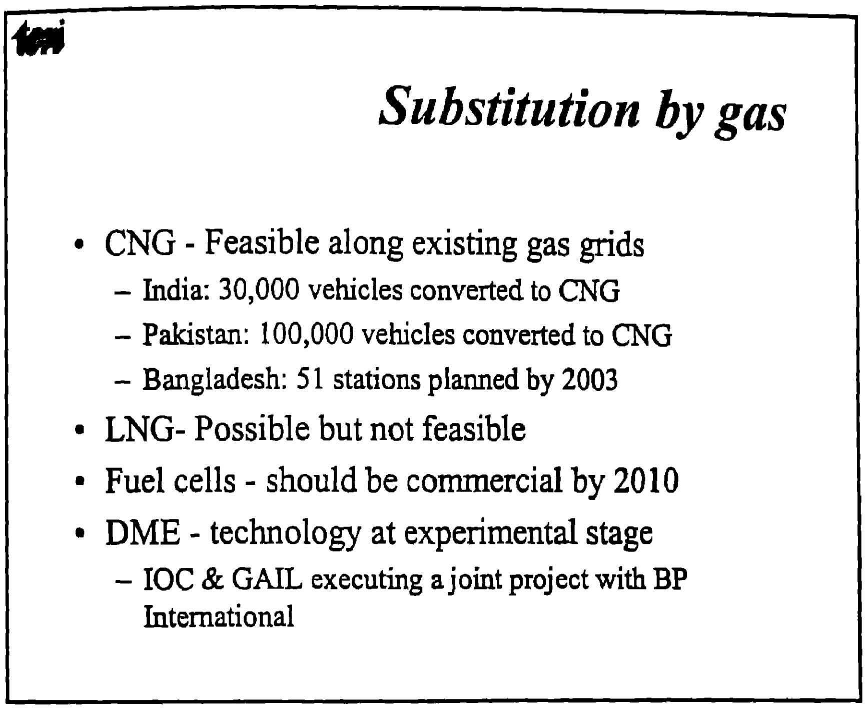
Problems with domestic coal

- Coal quality
- Railway capacity
- Environmental problems
- Land availability (ash disposal)

Reliance on imported coal likely to increase in the future

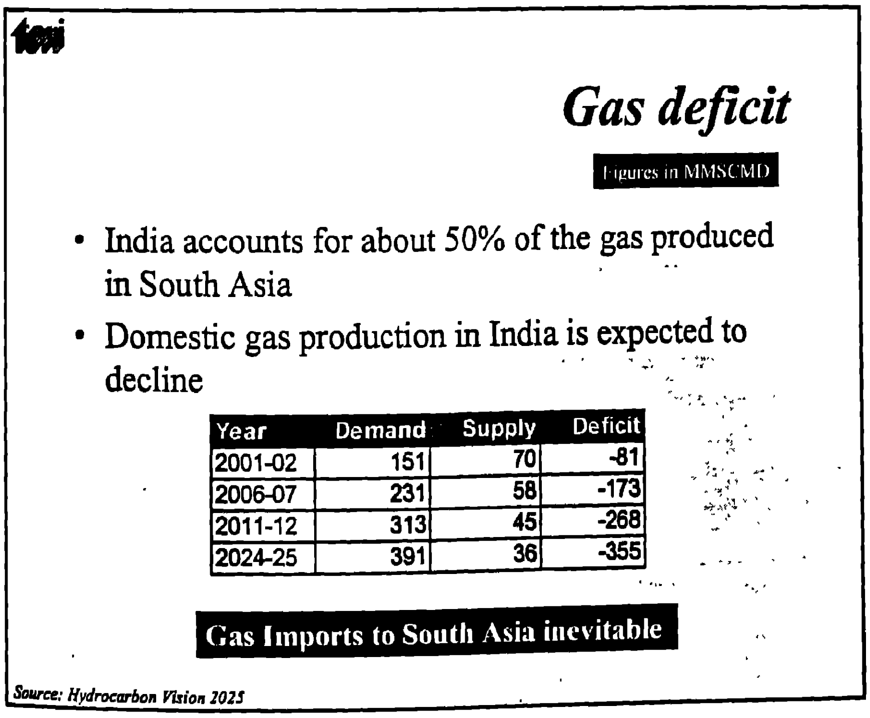
International coal market

- Lower price volatility
- Only a few large exporters
- 1990s marked by a gradual decline in prices



Substitution by gas

- CNG - Feasible along existing gas grids
  - India: 30,000 vehicles converted to CNG
  - Pakistan: 100,000 vehicles converted to CNG
  - Bangladesh: 51 stations planned by 2003
- LNG- Possible but not feasible
- Fuel cells - should be commercial by 2010
- DME - technology at experimental stage
  - IOC & GAIL executing a joint project with BP International



Gas deficit

Figures in MMSCMD

- India accounts for about 50% of the gas produced in South Asia
- Domestic gas production in India is expected to decline

Year	Demand	Supply	Deficit
2001-02	151	70	-81
2006-07	231	58	-173
2011-12	313	45	-268
2024-25	391	36	-355

Gas Imports to South Asia inevitable

Source: Hydrocarbon Vision 2025

Gas market

- No history of supply disruption
- Prices bilaterally agreed and more stable
- Global R/P ratio of 62 years

Shifting import dependence from oil to gas would enhance energy security

Gas imports: Pipelines

- **From Bangladesh**
  - Unocal has initiated proposal to export gas from Bibiyana field via a 1/2- bcfd pipeline
  - Bangladesh keen on gas exports only if domestic reserves cover requirements for next 50 years
- **From Iran**
  - Proposal to export gas from South Pars field in Iran to India & Pakistan mooted in 1995
  - Revived in 1999
    - Pakistan: Annual benefits of USD 700 million
    - India: Evaluating off-shore options

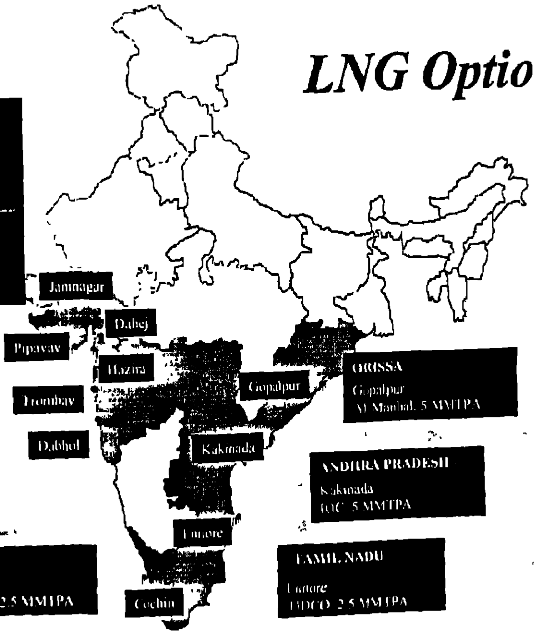
Regional Gas Grid

TERI's initiatives

- Proposal to develop gas grid under BIMST-EC (Bangladesh India Mayanmar Sri Lanka - Economic Co-operation)

LNG Options

GUJARAT
Pipavav
British Gas: 5 MMTPA
Hazira
Shell: 2.5 MMTPA; RPL: 5 MMTPA
Dahej
Petronet LNG: 5 MMTPA
Jamnagar
RPL: 5 MMTPA



ORISSA
Gopalpur
Al Manhal: 5 MMTPA

MAHARASHTRA
Dabhol
Enron: 5 MMTPA
Trombay
TOTAL-TEC: 3 MMTPA

ANDHRA PRADESH
Kakinada
IOC: 5 MMTPA

KERALA
Cochin
Petronet LNG: 2.5 MMTPA

TAMIL NADU
Ennore
TIDCO: 2.5 MMTPA

Coal vs imported fuels

- *Recently released India Hydrocarbon Vision 2025 takes note of the available import options but raises the question of implications of shift from indigenous coal to imported gas*

Future gas sources

- CBM
  - CBM policy announced in India in1997
    - Assessed resources: 850 BCM
    - First round of bidding expected soon
- Hydrates
  - Production technology not yet proven
  - Indian initiatives
    - Assessed resources: 9000 TCM mostly in deep waters
    - National Gas Hydrate Programme under implementation

Hydel

- Despite South Asia's huge potential for hydel power, hydro power accounted for only 3% of the primary energy in 1997
- Key problems with hydel projects
  - Large gestation period & capital outlay
  - Problems of rehabilitation & resettlement
- Power trade between India, Nepal & Bhutan

Nuclear

- Installed capacity
  - India: 2280 MW
  - Pakistan: 127 MW
- India's target capacity by 2020: 20000 MW
- Likely impediments
  - Decommissioning costs
  - Safety considerations

Renewables

- South Asia has a high reliance on renewables
  - Bhutan: 98%
  - Sri Lanka: 55%
  - Bangladesh: 50%
  - India: 40%
- India's R.E. policy targets 10% of future addition in power generating capacity to be based on renewables
- Costs associated with RETs continue to be high

Renewable energy potential: India

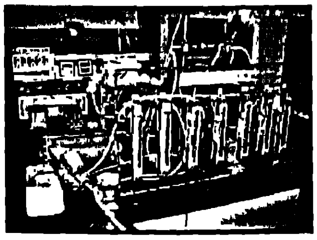
Source	Potential	Potential Exploited
Biogas plants	12 million	2.7 million
Biomass-based power	17,000 MW	69.5 MW
Efficient woodstoves	120 million	20 million
Solar energy	5x10^{6} GWh/yr	25 MW
Small hydro	10,000 MW	250 MW
Wind energy	20,000 MW	1,000 MW
Ocean thermal	50,000 MW	--
Sea wave power	20,000 MW	--
Tidal power	9,000 MW	--
Energy from wastes	1,700 MW	--

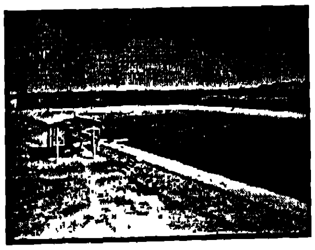
Source. Planning Commission 1999, and MNES 1999.

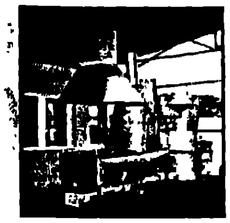
Interventions undertaken by TERI

Particulars	Numbers
Villages covered	98
Biogas plants (TERI model)	141
Solar lanterns	692
Solar home lighting systems	11
Improved Chulhas (cookstoves)	1120
Improved kerosene lanterns	2325
Solar water pumping systems	3
Solar water heating systems	7
Water mills	50

TERI's initiatives

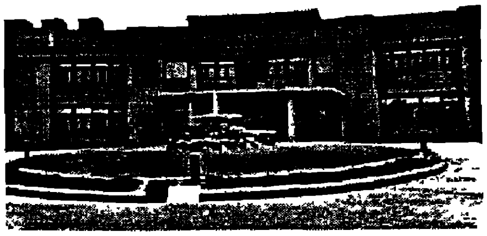

Molten Carbonate Fuel Cell


6000 sq.m. solar pond


Biomass gassifier

Vertical Shaft Brick-klin

Retreat - A sustainable habitat



Optimal design reduced energy load from 280 kW to 90 kW

Energy requirements met by:
- *Solar cells*
- *Biomass gassifier Genset*
- *Earth air tunnel*
- *Solar water heaters*

Efficiency improvements

- OECD countries doubled oil use efficiency after first oil shock
- Energy efficiency in South Asia comparatively much lower
  - Comparison of oil intensities:1998
    - India: 0.21 kgoe/USD
    - Pakistan: 0.38 kgoe/USD
    - Sri Lanka: 0.25 kgoe/USD
    - United Kingdom: 0.08 kgoe/USD

Diversification of supply

- Caspian Resources
  - Focus on westward evacuation routes
  - Legal status of Caspian Sea
- West Africa
  - Additional freight charges as compared to Middle East supplies
- South East Asia
  - Indonesia & Malaysia likely to be net oil importers by 2010

Stock draw Vs Demand restraint

Advantage: Stocks

- Stocks can be used immediately
- Less disruptive
- Measurable
- Price impact of stockdraw: Historical evidence
  - 1991: Price down by $15/bbl (Release of 34 Mb)
  - 2000: $37/bbl - $32/bbl (Release of 30 Mb)

...Stockdraw

- Timing of release critical in stockdraw
- Actual release at market determined price through auctions
- Benefits of release dependent on extent of market forces in energy markets
- Stock cover for South Asia
  - 90 days of cover (OECD norm) - 180 Mb in 2010
- Associated costs
  - Capital costs: USD 2.7 billion @ $15/bbl
  - Financing charges: USD 300 million
  - Oil inventory: USD 3 billion @ $20/bbl

High costs for an instrument with uncertain benefits

Response Strategies

I Introduction

II Energy Scenario in South Asia

III Energy Security Issues

IV Response Strategies

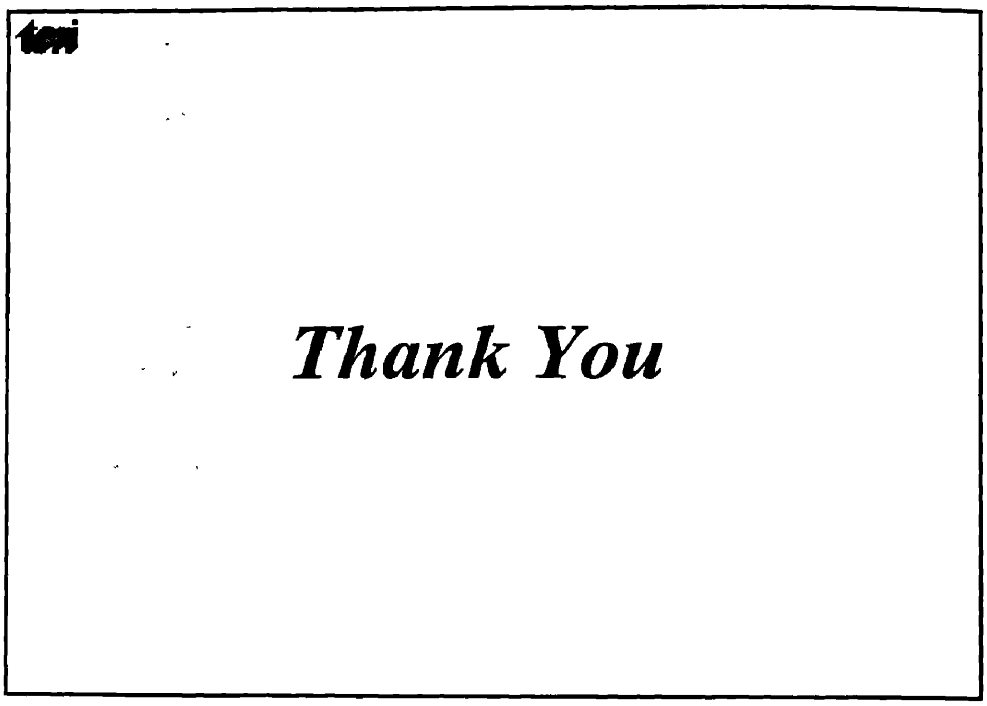
V **Key Issues**

Key issues...

- South Asia's oil requirements triple over the next two decades
- A larger proportion of the oil requirement would have to be imported – imports reaching to about 2 Mb/d by 2010
- South Asia's dependence on Middle East would continue to be high
- Institutional problems in energy trade in South Asia remain

...Key issues

- Role of indigenous resources (coal) in enhancing energy security questionable
- Tapping the region's hydro potential while taking care of environmental concerns
- Limited gains till date from R&D efforts, efficiency improvements and renewables against their immense potential



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Thank You

Annexure B

Presentation by Mr Tatsuo Masuda
Director, International Energy Agency

Workshop on Energy Security Concerns and
Response Strategies for South Asia
(Organised by TERI)

Towards Global Energy Security: The Need for Broader Co-operation

10 February 2001

New Delhi, India

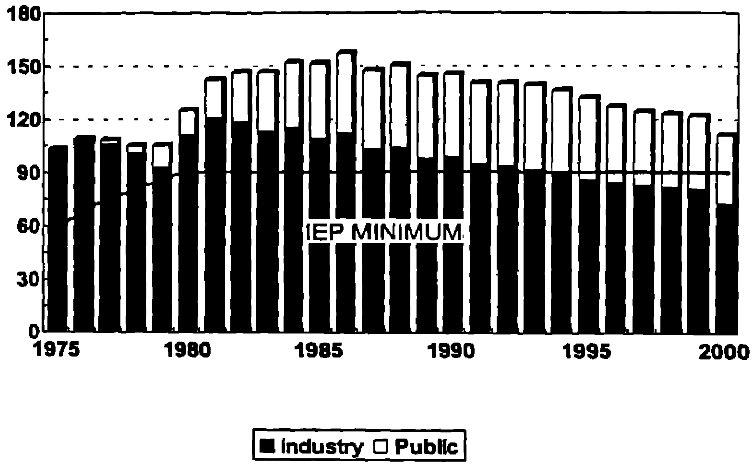
by

Tatsuo Masuda
Director
Office of Oil Markets and Emergency Preparedness
International Energy Agency
Paris

Total Final Energy Consumption by Region

TFC	1971	1997	2010	2020	1971	1997	2010	2020	1971-1997	1997-2010	1997-2020
	Mtoe				Shares (%)				Growth Rates (%)		
World	3627	5808	7525	9117	100%	100%	100%	100%	1.8%	2.0%	2.0%
OECD	2521	3267	3805	4116	69%	56%	51%	45%	1.0%	1.2%	1.0%
North America	1354	1633	1908	2067	37%	28%	25%	23%	0.7%	1.2%	1.0%
Europe	926	1214	1414	1528	26%	21%	19%	17%	1.0%	1.2%	1.0%
Pacific	241	420	483	521	7%	7%	6%	6%	2.2%	1.1%	0.9%
Transition Economies	579	649	765	850	16%	11%	10%	10%	0.4%	1.3%	1.7%
Developing Countries	528	1892	2955	4051	15%	33%	39%	44%	5.0%	3.5%	3.4%
China	184	613	937	1259	5%	11%	12%	14%	4.7%	3.3%	3.2%
East Asia	77	366	608	850	2%	6%	8%	9%	6.2%	3.9%	3.7%
South Asia	51	197	358	548	1%	3%	5%	6%	5.3%	4.7%	4.6%
Latin America	124	351	539	710	3%	6%	7%	8%	4.1%	3.4%	3.1%
Middle East	35	223	309	414	1%	4%	4%	5%	7.4%	2.5%	2.7%
Africa	56	142	205	269	2%	2%	3%	3%	3.6%	2.8%	2.8%

Stocks of IEA Net Importers (days of net imports)



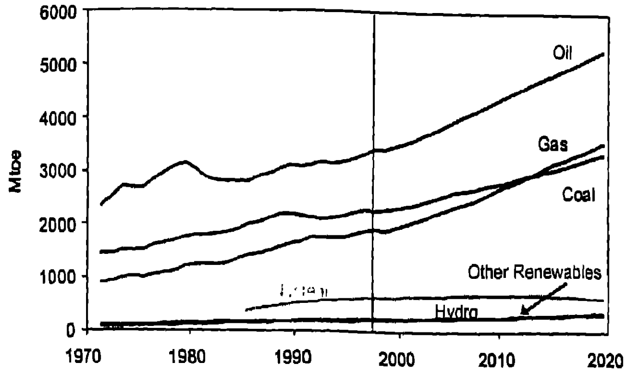
World Oil Balance

(million barrels per day)

	1997	2010	2020	1997 – 2020 (a a p)*
Total Demand	74.5	95.8	114.7	1.9
OECD	*40.9*	*46.9*	*50*	*0.9*
North America	20.2	24	26.1	1.1
Europe	14.1	16	16.8	0.7
Pacific	6.5	7	7.1	0.4
Non-OECD	*30.1*	*45*	*60*	*3.1*
Transition Economies	4.7	5.8	7.4	2
China	4.1	7.6	11	4.4
East Asia	6.4	10.1	13.6	3.3
South Asia	2.3	4.1	6.2	4.5
Latin America	6.1	8.7	10.9	2.5
Africa	2.1	3	3.9	2.7
Middle East	4.4	5.7	7	2.1
Bunkers and stock changes	3.6	3.9	4.6	1.1
Total Supply	74.5	95.8	114.7	1.9
Non-OPEC	*42*	*44.9*	*46.1*	*0.4*
OECD	18	15.7	13.1	-1.4
North America	10.6	9.9	9	-0.1
Europe	6.7	5.2	3.5	-2.7
Pacific	0.7	0.6	0.5	-1.3
Transition Economies	7.4	10.3	12.3	2.2
Russia	6.1	7.1	7.9	1.1
Other Transition Economies	1.3	3.2	4.4	5.3
China	3.2	3	2.6	-1
India	0.8	0.5	0.4	-2.6
Other Asia	1.4	1.6	1.4	-0.1
Brazil	0.9	2.4	3.2	5
Other Latin America	5.7	6.8	6.8	0.7
Africa	2.7	4.8	4.8	2.5
Middle East	1.9	1.8	1.6	-0.8
OPEC	*29.8*	*44.1*	*61.8*	*3.2*
OPEC Middle East	19.5	30.5	46.7	3.9
Other OPEC	10.3	13.6	15.1	1.7
Unconventional Oil	1.3	2.7	4.2	5.4
Processing Gains	1.6	2.2	2.6	2.2
OPEC Share (%)	40	46	54	1.3
OPEC Middle East Share (%)	26	32	41	2

* Annual average percentage change

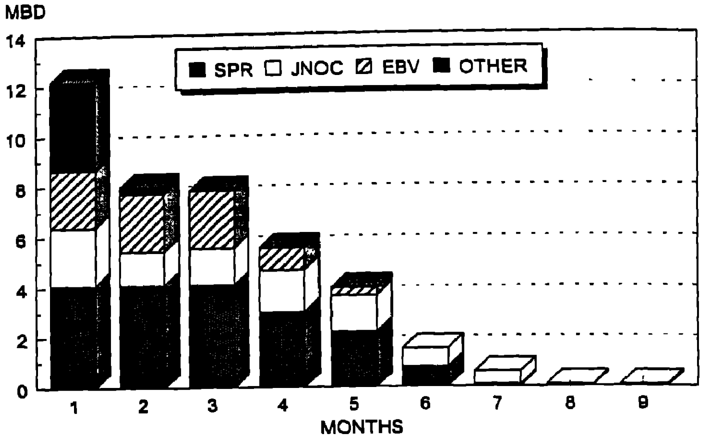
World Primary Energy Supply by Fuel 1971-2020



Oil Import Dependence (%)

	1997	2010	2020
North America	44.6	52.4	58.0
Europe	52.5	67.2	79.0
Pacific	88.8	91.5	92.4
OECD	**54.3**	**63.3**	**70.0**
China	22.3	61.0	76.9
India	57.4	85.2	91.6
East Asia	53.7	70.5	80.7
Rest of South Asia	87.2	95.1	96.1

Maximum Drawdown Profile for Public IEA Stocks



10 January 2001

T. Masuda
(IEA)

" Two Cushions in the Oil Market"

The oil market will continue to be volatile this year unless two "cushions" are replenished. Last year, for the irst time in recent history, OPEC oil producers publicly and repeatedly stated that oil prices should not be "too high" but "moderate". For this purpose they increased production targets four times within a year.

Why have oil prices have been so volatile despite all these efforts? A "two cushion theory " may answer this uestion, although running the risk of oversimplification. OECD industry stocks declined very sharply since mid-1999. At the end of the third quarter of 2000, they stood at some 2.5 billion barrels. That sounds like a lot, but if you translate into "days of forward demand" (stocks divided by daily demand in the forthcoming quarter), it is equivalent to just 52 days. As the oil-supply-chain is extremely long and complex, reasonable oil stocks are needed to maintain a smooth operation to serve final consumers. Recent levels of industry stocks are too low, even considering the effect of "just-in-time" inventory policies widely adopted by oil companies since the mid-90's. As a "cushion" in the oil market, stock levels of around 54 -56 days would be "comfortable" by rule of thumb.

OECD Industry Stocks

(days of forward demand)

1997				1998				1999				2000		
1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q
57	56	55	56	58	59	58	56	58	58	55	52	53	53	52

The other "cushion " is the spare production capacity of OPEC countries. Non-OPEC oil producers would produce oil at full capacity to maximize the returns on investment. By contrast, OPEC producers hold spare capacity, which works as a "cushion" to mitigate the impact of irregularity in the oil supply such as erratic Iraqi oil exports. As is widely known, Saudi Arabia historically maintains by far the largest spare capacity to "enhance world oil supply security".

OPEC production capacity growth had been suppressed by financial constraints due to the oil price drop of 1997/98, when oil prices fell to less than $10 per barrel. A series of production cuts in 1998 and 1999 also removed the incentive to increase, or even to maintain, production capacity. After production cuts started in early 1998, spare capacity naturally showed some increase, but only temporarily. Soon after they began increasing production in 2000, the market started to worry about OPEC's narrowing spare capacity. Indeed, its current level is just above 2 million barrels per day, the lowest level in the last three decades.

OPEC Spare Production Capacity

(million barrels per day)

	1994	1995	1996	1997	1998	1999	2000
OPEC 10	4.2	3.9	3.6	3.2	3.7	4.5	2.2
Of which Saudi	2.2	2.1	2.1	2.0	2.1	2.7	1.7

Sources: IEA estimates

OPEC 10: OPEC countries excluding Iraq

Timing: Annual average except for 2000 (year-end)

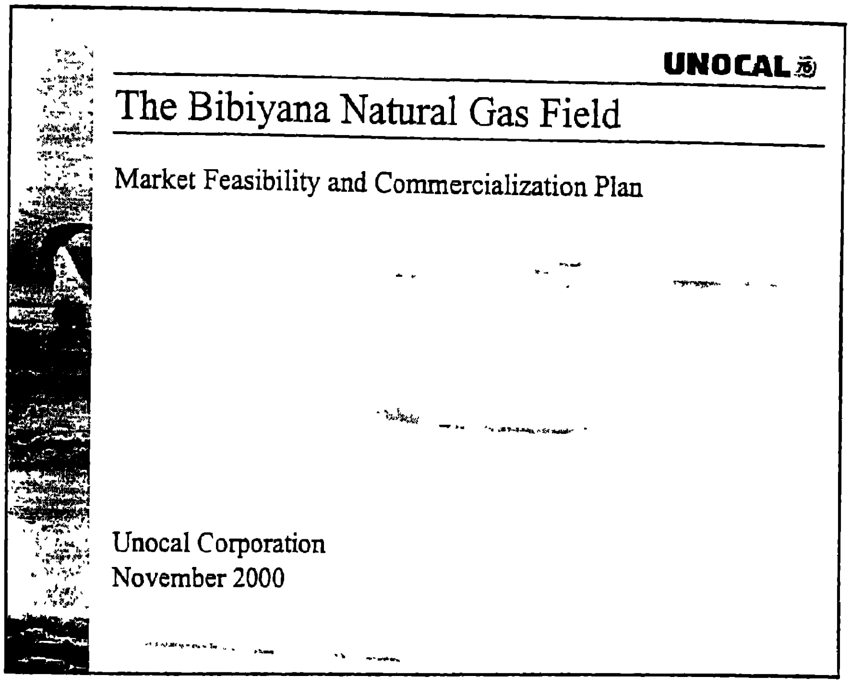
One of the lessons from the recent oil market experience is that this huge and complex market needs comfortable "cushions" as shock -absorbers. Nevertheless, it is unlikely that OECD industry stocks will increase quickly. The global oil demand is expected to decline seasonably by some two million barrels per day from this quarter to the second quarter. The experience of 1997/98 price drop was extremely painful for producers. This time, OPEC may act very quickly to cut production, thereby preventing OECD industry stocks from recovering to reasonably comfortable levels.

The growth of OPEC production capacity depends on the upstream investment in the oil sector by producers, where oil revenues have to satisfy various important budgetary needs: social welfare, medical care, education, industry development, defence, etc. Although increased oil revenues due to strong oil prices have begun to increase upstream investment, it takes time for oil production capacity (including spare capacity) to grow especially when investment has been reduced for a sustained period.

So, 2001 will be another year of oil market volatility. However, one encouraging element will be present, that is, increased dialogues between producers and consumers. They emphasised the need for greater oil market transparency at the Seventh International Energy Forum in Riyadh last November, and co-operation is already underway. Increased transparency will lead to less volatility of the oil market. Let us work towards this.

Annexure C

Presentation by Mr Ron Somers
President, Unocal Bharat Services Private Limited



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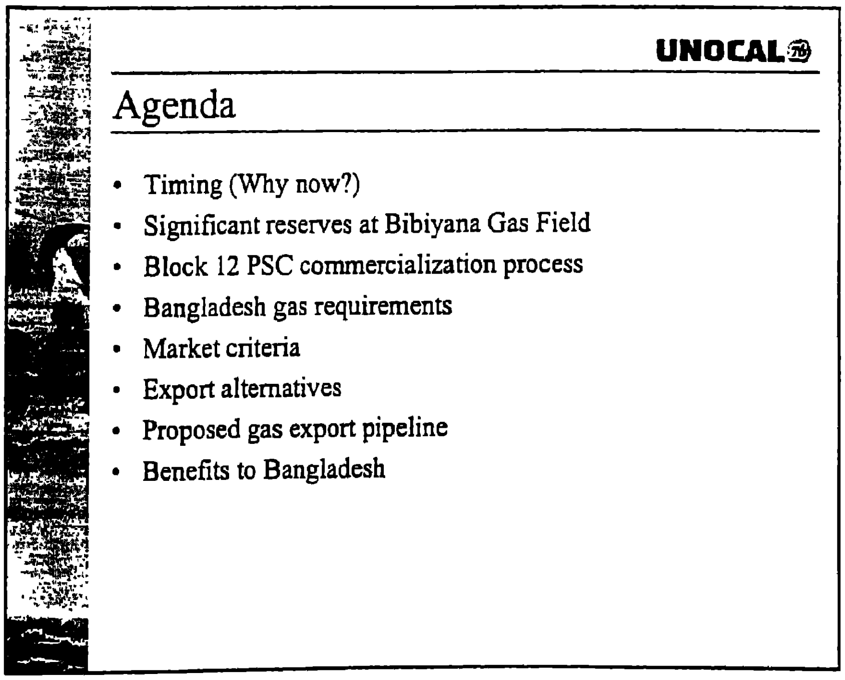
The Bibiyana Natural Gas Field

Market Feasibility and Commercialization Plan

Unocal Corporation
November 2000



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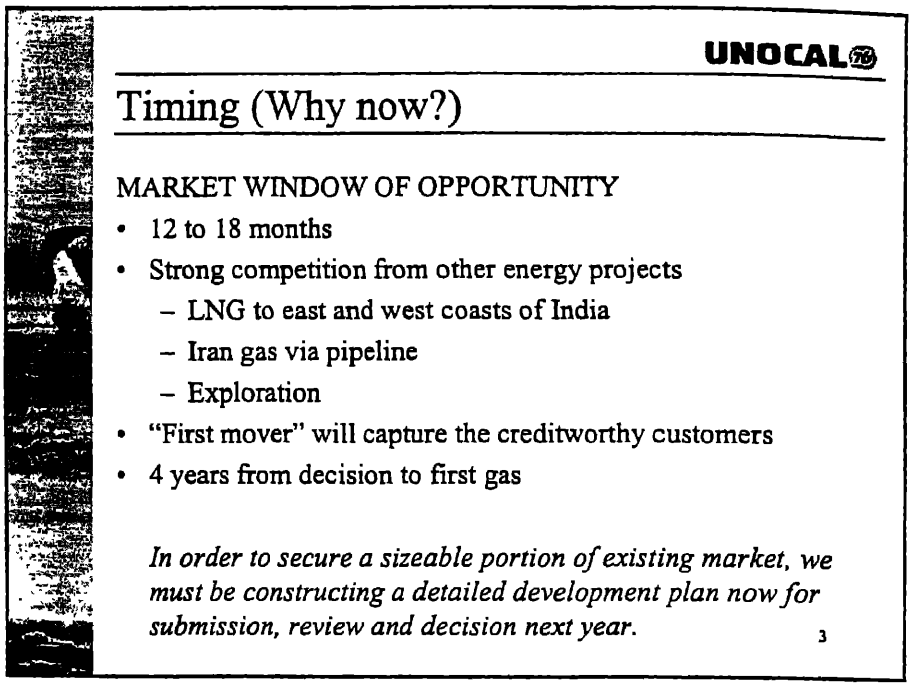
Agenda

- Timing (Why now?)
- Significant reserves at Bibiyana Gas Field
- Block 12 PSC commercialization process
- Bangladesh gas requirements
- Market criteria
- Export alternatives
- Proposed gas export pipeline
- Benefits to Bangladesh



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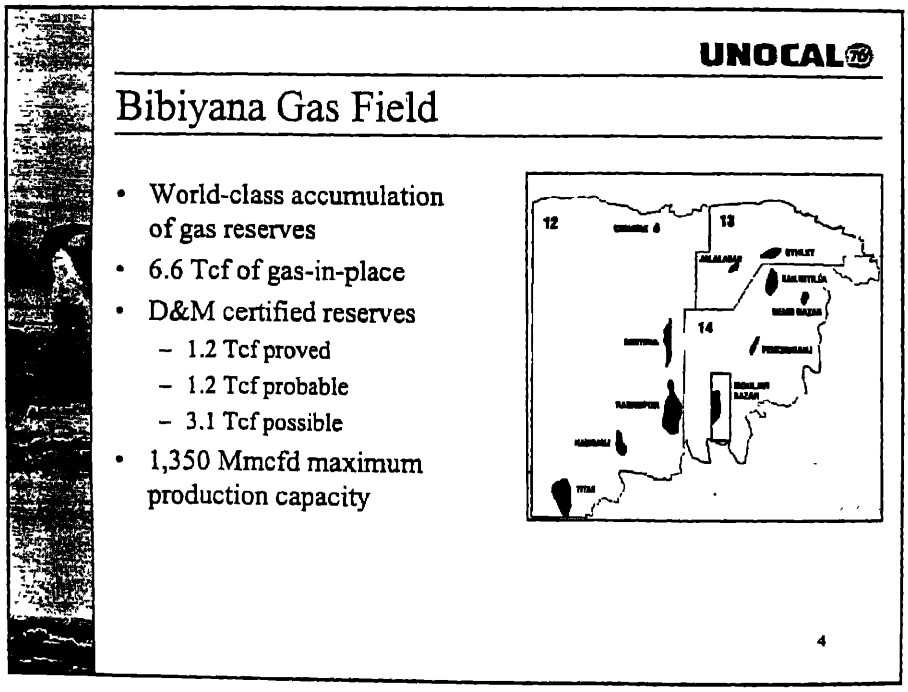
Timing (Why now?)

MARKET WINDOW OF OPPORTUNITY

- 12 to 18 months
- Strong competition from other energy projects
  - LNG to east and west coasts of India
  - Iran gas via pipeline
  - Exploration
- "First mover" will capture the creditworthy customers
- 4 years from decision to first gas

In order to secure a sizeable portion of existing market, we must be constructing a detailed development plan now for submission, review and decision next year.



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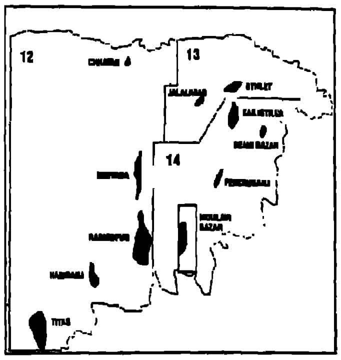
Bibiyana Gas Field

- World-class accumulation of gas reserves
- 6.6 Tcf of gas-in-place
- D&M certified reserves
  - 1.2 Tcf proved
  - 1.2 Tcf probable
  - 3.1 Tcf possible
- 1,350 Mmcfd maximum production capacity

12
13
14
JALALABAD
SYLHET
KAILASTILA
BEANI BAZAR
RASHIDPUR
TITAS

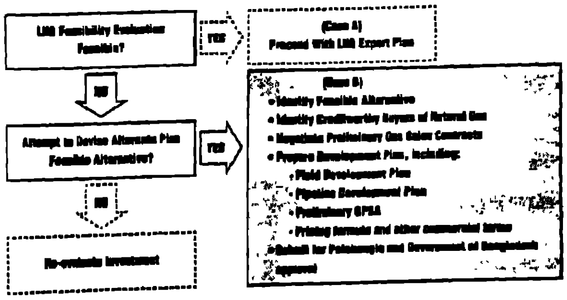
Jalalabad Gas Field/Moulavi Bazar

- 1.6 Tcf of gas-in-place
- 175 to 200 Mmcfd production capacity
- Production currently limited to 80 Mmcfd by Petrobangla
- Submitted plan to increase Jalalabad production
- Petrobangla requested alternative plan with lower production and longer plateau



- Significant discovery at Moulavi Bazar; evaluation underway

Block 12 PSC Commercialization Process


LNG Feasibility Evaluation Feasible?

YES

(Case A)
Proceed With LNG Export Plan

NO

Attempt to Devise Alternate Plan Feasible Alternative?

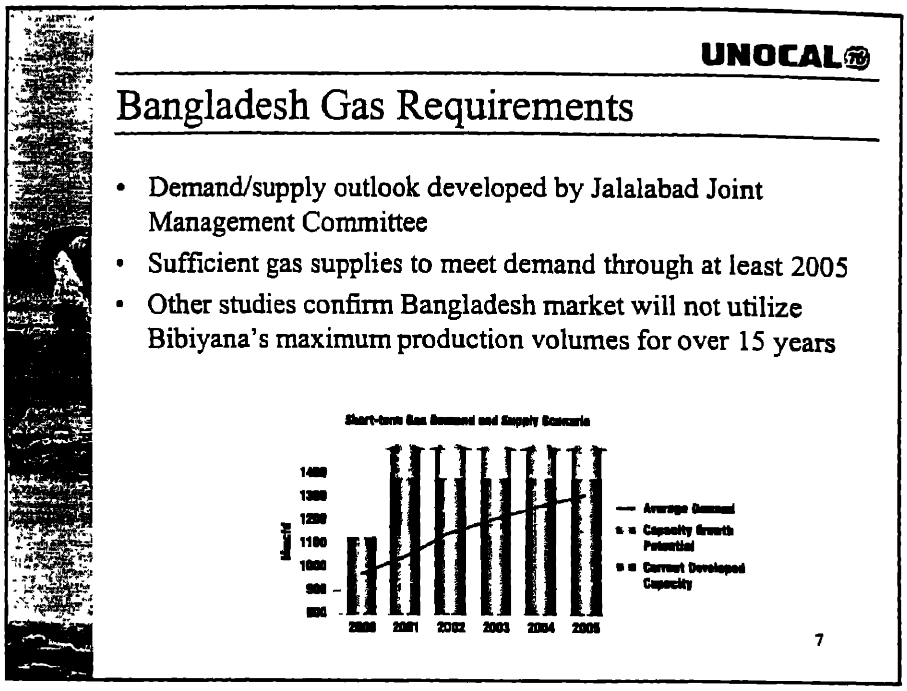
YES

(Case B)
- Identify Feasible Alternative
- Identify Creditworthy Buyers of Natural Gas
- Negotiate Preliminary Gas Sales Contracts
- Prepare Development Plan, including:
  - Field Development Plan
  - Pipeline Development Plan
  - Preliminary GPSA
  - Pricing formula and other commercial terms
- Submit for Petrobangla and Government of Bangladesh approval

NO

Re-evaluate Investment

- Unocal seeks to commercialize Bibiyana reserves
- Under Block 12 PSC, Contractor can export gas as LNG
- If LNG not commercially feasible, Contractor can recommend acceptable alternative export plan, taking into account Bangladesh requirements



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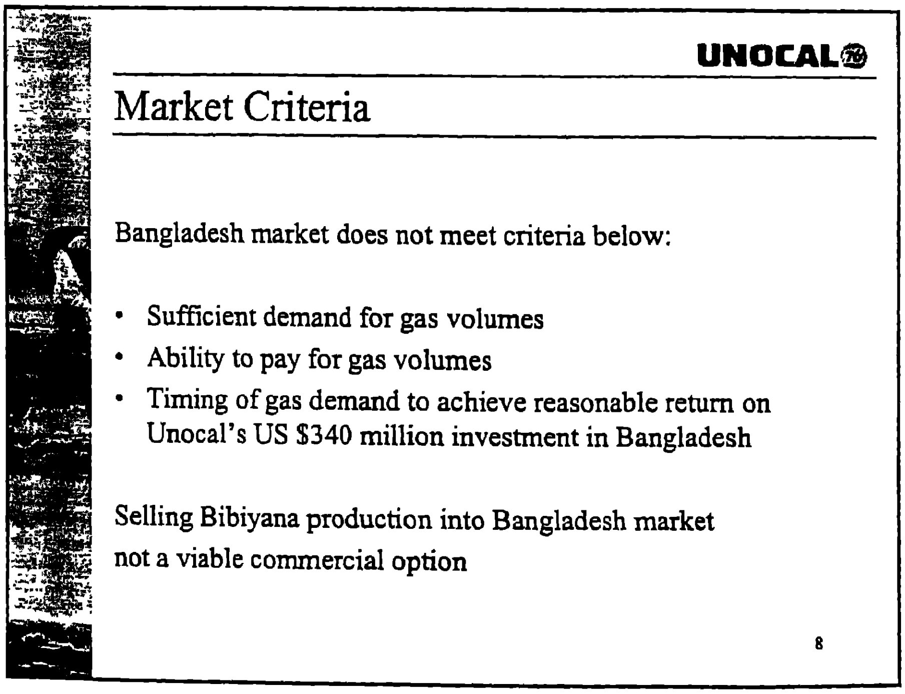
Bangladesh Gas Requirements

- Demand/supply outlook developed by Jalalabad Joint Management Committee
- Sufficient gas supplies to meet demand through at least 2005
- Other studies confirm Bangladesh market will not utilize Bibiyana's maximum production volumes for over 15 years

Short-term Gas Demand and Supply Scenario
MMcfd
1400
1300
1200
1100
1000
900
800
2000
2001
2002
2003
2004
2005
Average Demand
Capacity Growth Potential
Current Developed Capacity



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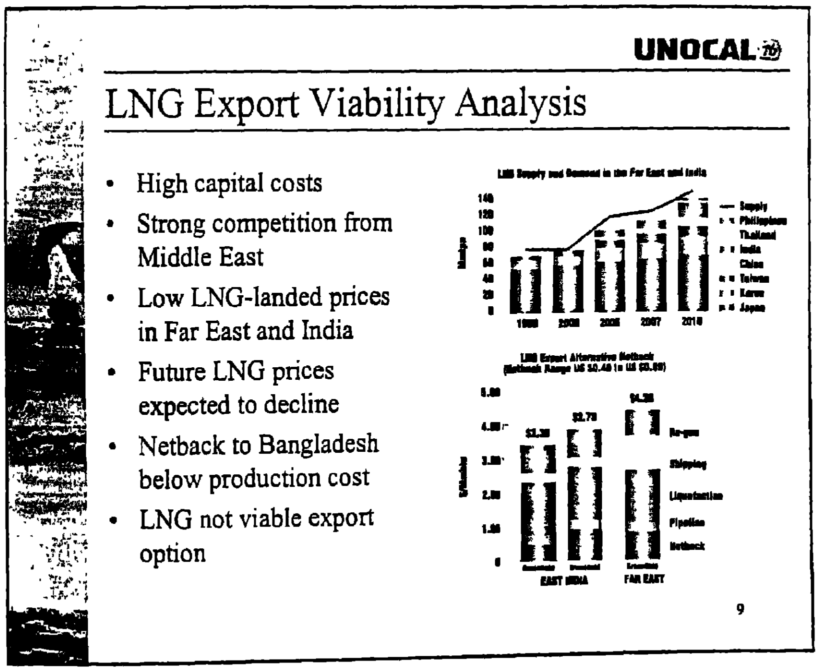
Market Criteria

Bangladesh market does not meet criteria below:

- Sufficient demand for gas volumes
- Ability to pay for gas volumes
- Timing of gas demand to achieve reasonable return on Unocal's US $340 million investment in Bangladesh

Selling Bibiyana production into Bangladesh market not a viable commercial option


LNG Supply and Demand in the Far East and India
140
120
100
80
60
40
20
0
1999
2000
2005
2007
2010
Supply
Philippines
Thailand
India
China
Taiwan
Korea
Japan
LNG Export Alternative Netback
(Netback Range US $0.48 to US $3.88)
5.00
4.00
3.00
2.00
1.00
0
$3.38
$3.73
$4.38
Re-gas
Shipping
Liquefaction
Pipeline
Netback
EAST INDIA
FAR EAST

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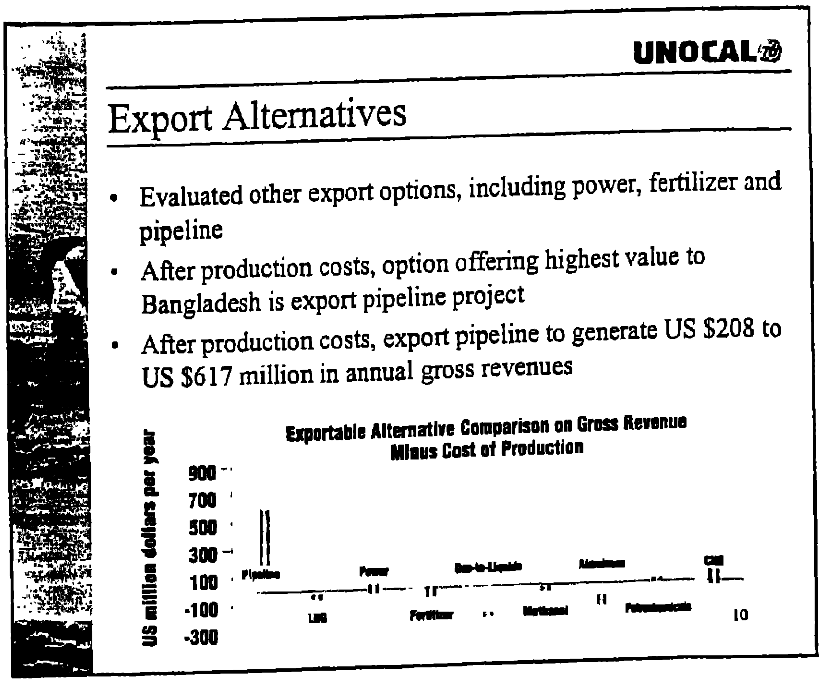
LNG Export Viability Analysis

- High capital costs
- Strong competition from Middle East
- Low LNG-landed prices in Far East and India
- Future LNG prices expected to decline
- Netback to Bangladesh below production cost
- LNG not viable export option


Exportable Alternative Comparison on Gross Revenue
Minus Cost of Production
US million dollars per year
900
700
500
300
100
-100
-300
Pipeline
LNG
Power
Fertilizer
Gas-to-Liquids
Methanol
Aluminum
Petrochemicals
Coal

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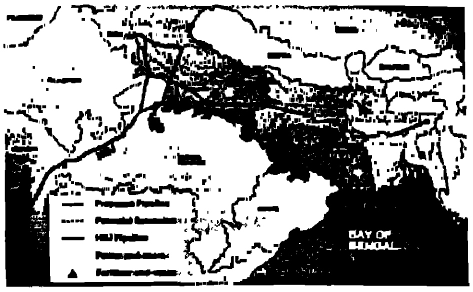
Export Alternatives

- Evaluated other export options, including power, fertilizer and pipeline
- After production costs, option offering highest value to Bangladesh is export pipeline project
- After production costs, export pipeline to generate US $208 to US $617 million in annual gross revenues

Proposed Gas Export Pipeline



- Proposed route from Rashidpur to HBJ Pipeline in north central India
- 1,350 kilometers (850 miles) in length, 30-inch diameter
- Average flow rate of 500 Mmcfd, peak volume of 555 Mmcfd
- Four years to construct and begin production
- Total cost of US $910 million
- Annual operating cost of US $17 million

Export Pipeline Market

- Gas supply shortfall along route to grow from 1 Bcfd in 2005 to over 4 Bcfd in 2010
- Window of opportunity to capture creditworthy India market expected to close within next 12 to 18 months
- Strong competition from other energy projects
- Export pipeline to serve customers in Delhi area market, along the HBJ Pipeline and along the proposed route in Bangladesh and India

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Commercial Structure

- Unocal purchases Petrobangla's share of Bibiyana gas under PSC price formula
- Gas shipped via Trans-Bangladesh Pipeline Co.
- Unocal sells gas at Bangladesh/India border to customers
- Proposed sales price at border equal to at least same indexed price for gas sales at wellhead plus transportation tariff
- Gas purchasers ship gas to end-users via Trans-India Pipeline
  - See flowchart on next slide

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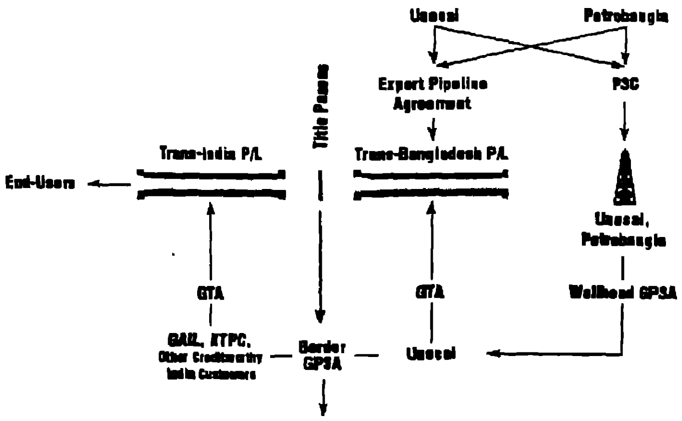
Commercial Structure Flowchart

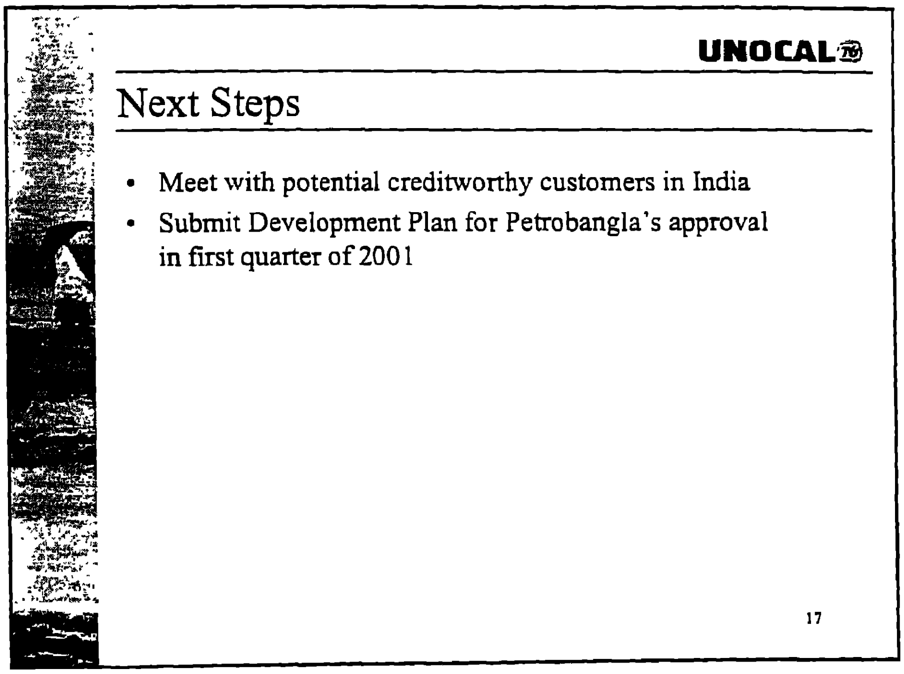


Benefits to Bangladesh

- Estimated US $3.5 billion (185 trillion taka) in revenues and tax receipts to Government of Bangladesh over 20-year life of project
- Approximately 1,900 jobs for Bangladesh citizens
- Estimated US $55 to US $75 million for local procurement during construction phase
- New and enhanced community development projects
- New domestic infrastructure
- Generation of foreign exchange revenue
- Opportunity to create energy security fund

Summary

- Bibiyana represents world-class gas field
- Joint Unocal/Petrobangla studies demonstrate Bangladesh market cannot utilize Bibiyana's production potential
- Block 12 PSC grants Unocal right to commercialize Bibiyana Gas Field
- LNG and other export alternatives evaluated under PSC commercialization process
- Gas export pipeline represents only viable commercial option
- Pipeline creates greatest value for Bangladesh and provides substantial benefits for its citizens



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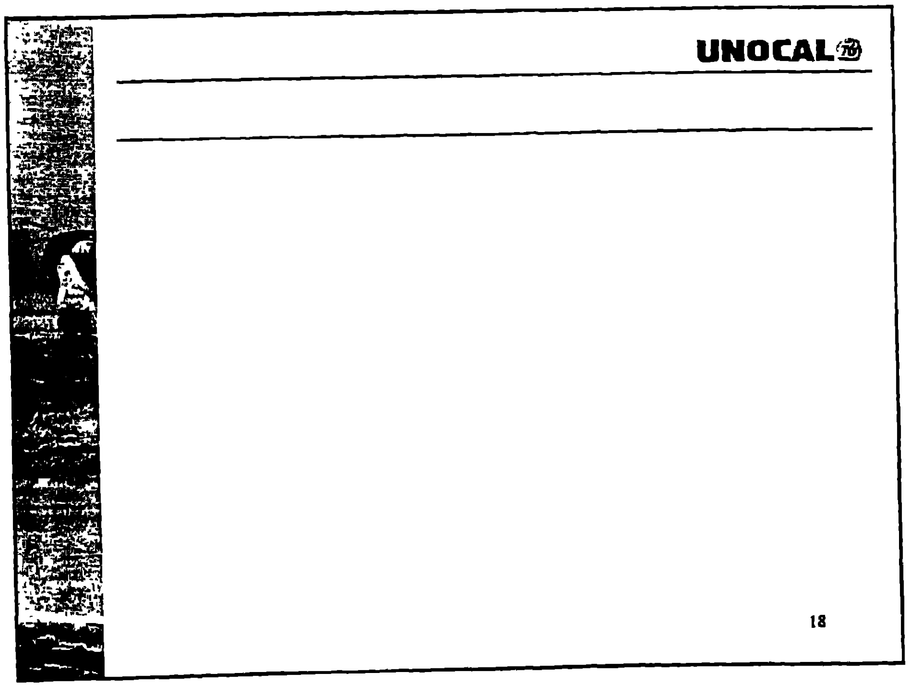
Next Steps

- Meet with potential creditworthy customers in India
- Submit Development Plan for Petrobangla's approval in first quarter of 2001



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Annexure D

Presentation by Mr Hilal A Raza Director General, Hydrocarbon Development Institute of Pakistan

Workshop on Energy Security Concerns and Response Strategies for South Asia

Energy Trade – A Vehicle for Economic Cooperation and Energy Security in South Asia

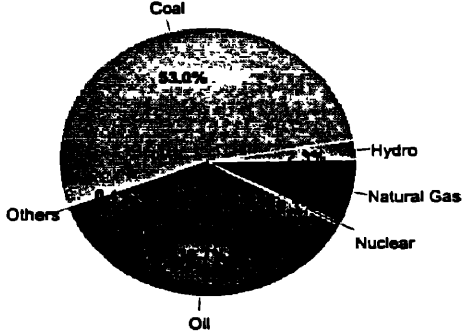
by

Hilal A. Raza
Director General
Hydrocarbon Development Institute of Pakistan

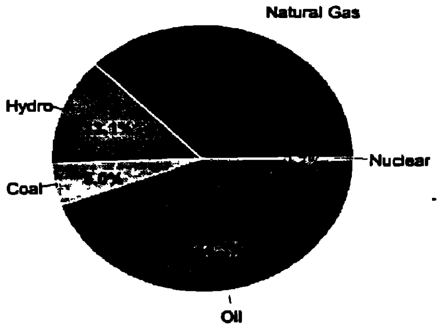
TERI, New Delhi: 10 February 2001

Energy Mix

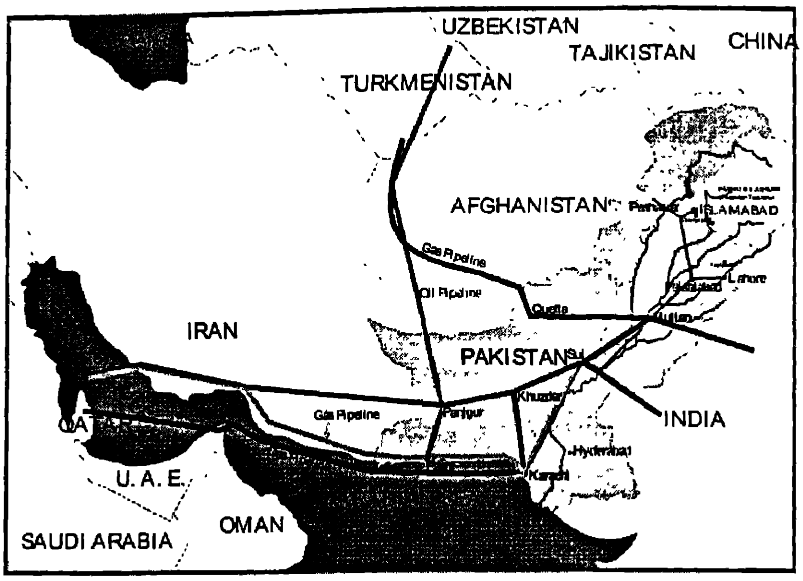
India
(310 Million TOE)



Pakistan
(44 Million TOE)



Proposed Oil & Gas Import Routes



Major Benefits

- Substitution of more expensive imported liquid fuels with consequent improvement in balance of payment.
- Relief to the hard-pressed infrastructure of ports, roads and railways used in movement of imported liquid petroleum.
- Shift towards gas-driven environment friendly energy economies.
- Reduction in the cost of electricity generation.

Major Benefits (contd.)

- Direct and indirect economic benefits of the project through employment, transit fees, availability of clean fuel, economic and industrial growth.
- Creation of new business and investment opportunities.
- Strengthen regional cooperation and provide a foundation for future economic growth throughout the region.
- Lower the regional tensions leading to quicker and sustainable resolution of other problems.

Capital & Operating Costs and Tariff of Fully Optimized Pipeline with Compression

	Specs	Capital Cost (Billion US$)	Annual Operating Cost (Million US$)	Tariff @15% RoR & 49% Tax (US$/ Million BTU)
Pakistan only	**1.5 bcf/d** **36”** **2,800 km**	**2.54**	**35 – 55**	**1.03**
Pakistan+India	**3.5 bcf/d** **48”** **3,200 km**	**4.10**	**50 – 120**	**0.76**

TOR for TERI-HDIP Study

- Take stock of the present status of the proposals to bring natural gas into Pakistan and India.
- Identify the crucial bottlenecks in implementing the project.
- Propose possible solutions to the problems identified.
- Sensitize the policy making classes to the pros and cons of the proposed projects with a view to securing their support for the project.
- Propose an institutional and legal framework to be agreed between the governments to ensure smooth operation of the project.

Conclusions

- Optimal techno-economic solution is for India and Pakistan to jointly pose their demands to potential suppliers in the north and the west so that economies of scale result in a substantial reduction in the unit cost of supply to both countries.
- A land route via the territory of Pakistan is the preferred option for economic, technical and security of supply considerations.

Conclusions (contd.)

- Inter-governmental arrangements between India and Pakistan are needed to signify a joint declaration of intent and inuring the project from perceived non-commercial risks.
- Four major directions through which an appropriate climate of opinion can progressively be created are:
  - Full fledged preparatory techno-economic work.
  - Intergovernmental agreement.
  - Informed public opinion.
  - Promotion of international commercial and financial interest in the proposed projects.

Conclusions (contd.)

- The governments of India and Pakistan are urged to positively pursue these proposals and address themselves to a number of issues including commercial terms, identification of routes, security of supplies, non-commercial risks such as natural disasters, political tensions, internal disturbances, terrorism, armed hostilities and international sanctions, joint supervision mechanism, modalities for settlement of disputes, and a time-frame.

Conclusions (contd.)

- Non-governmental or quasi-governmental organizations can play an effective role in carrying out preparatory work necessary for undertaking such a large multi-national venture which has no precedence in the region.

Workshop on Energy Security Concerns and Response Strategies for South Asia

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